SCIENTIFIC AMERICAN SUPPLEMENT. No. 1065

Copyright, 1896, by Munn & Co.

Scientific American Supplement, Vol. XLI. No. 1065. Scientific American, established 1845. NEW YORK, MAY 30, 1896. Scientific American Supplement, $5 a year. Scientific American and Supplement, $7 a year.

THE NILE EXPEDITION.

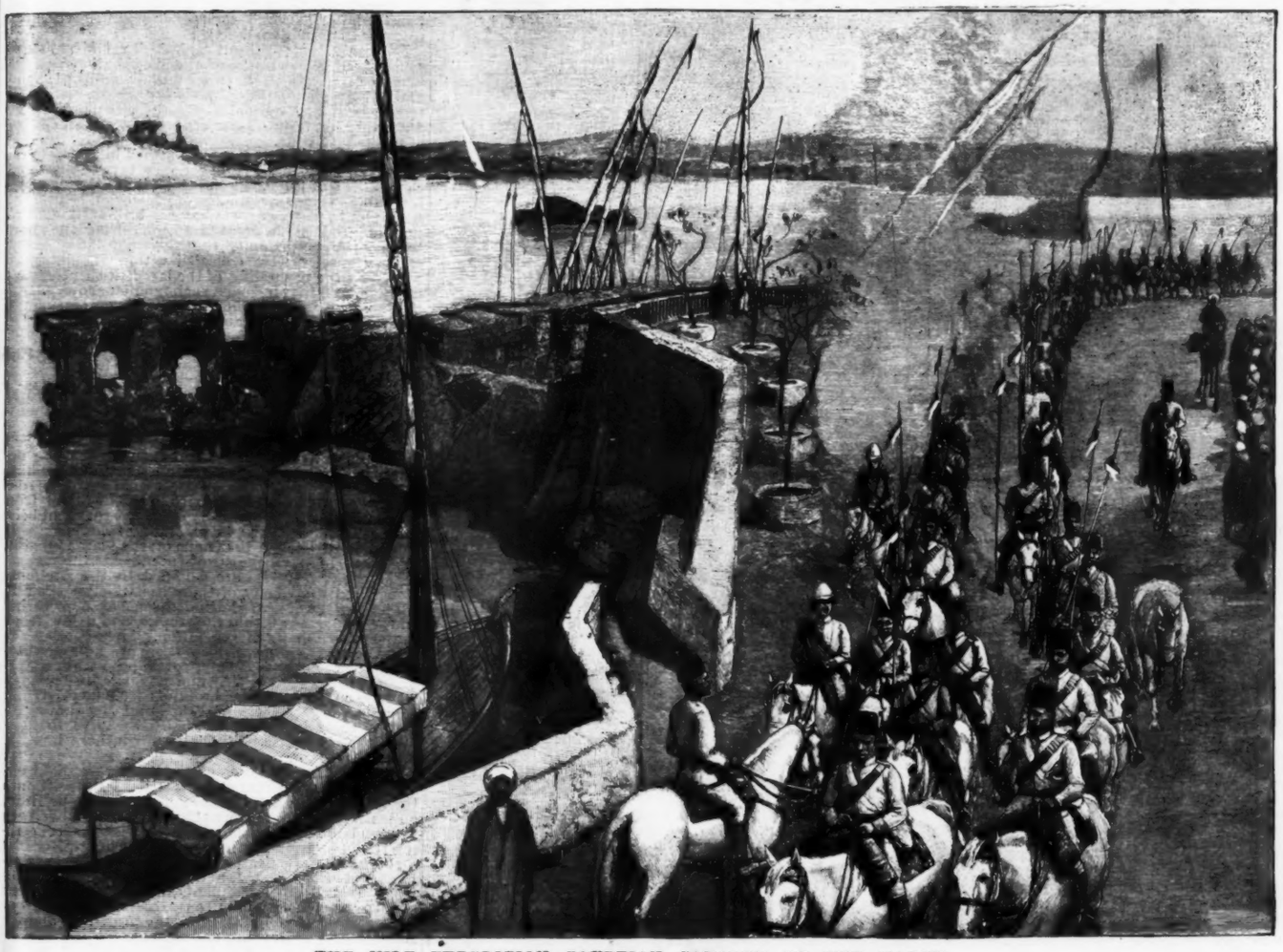
THE present military campaign in Upper Egypt is being conducted in some respects to better advantage than that of 1884 under Lord Wolseley. The latter was undertaken for the relief of the garrison at Khartoum, and in response to urgent appeals from General Gordon, who was known to be hard pressed by the beleaguering army of the Mahdists. If the gallant general was to be saved from butchery, it was necessary for the invading army to push forward with all possible haste. The advance was marked by a series of forced marches through a country known to be thickly infested by the enemy, and the line of communications was necessarily but feebly maintained. The campaign was not primarily undertaken with the idea of conquest; and when the ill-fated expedition reached Khartoum just forty-eight hours late, and it was found that it had failed in its purpose, the troops were soon withdrawn again to the regions of Lower Egypt.

The present campaign, on the other hand, aims at the re-conquest of the upper country, and the subjugation or expulsion of the Mahdists. Whereas in the earlier expedition haste was essential, now the invaders may take all the time they please. A writer in a recent number of the Fortnightly Review, Major Griffiths, points out that a cautious advance is both possible and expedient. "We are not now obliged to reach out in the dark and strike at the enemy wherever we can find him. He may be awaited in our own positions on the ground we have made good. This notion of gradual advance, of creeping conquest, as it may be called, has been derided, although there is nothing laughable in it; on the contrary, it is the wisest course, and that best adapted to the circumstances of the case. It can be effected by the means actually at hand; it may be made the business of the Egyptian army. It is of course right and proper that if the recovery of the Soudan is to be undertaken in Egypt's best interests, it should be attempted by Egypt alone."

The advance of the Egyptian army thus far has been marked by caution and the maintenance of a strong line of communication. The only exception, perhaps, was seen in the dash across the desert from Sarras to Akasheh, a distance of 110 miles; but, fortunately, the enemy did not make any demonstration, and Akasheh was occupied without opposition. The first encounter with the enemy took place near Akasheh, on May 1. A hostile force of some 250 horsemen and camel riders, with 1,000 foot soldiers, advanced to within four miles of the outpost, threatening the line of communication. They were met by three squadrons of cavalry, supported by the eleventh Soudanese battalion of infantry. It was the first brush with the enemy for the Nile expedition, and the native soldiers showed the same fighting qualities as were displayed by the troops at Suakin in the recent operations. The cavalry are reported to have charged with great dash and courage, throwing the enemy into disorder, and driving them off before the Soudanese infantry could come up, much to the disappointment of the black troops, who are eager to try their mettle against their old-time enemy.

It seems that the Mahdist is not the only obstacle to the progress of the army. The heat of the Soudanese desert is proverbial, and on the occasion of this fighting, which took place in a ravine, the temperature rose to 116° in the shade. At Wady Halfa, on the Nile, it is spoken of as being terrific, reaching 150° in the open. This success of the cavalry has greatly inspirited the little army of invasion, for the men have shown the good effects of the thorough discipline and training of the past few years.

The reconstruction of the old unfinished line from Sarras to Akasheh is greatly facilitating the transportation of Egyptian troops and stores to the front. The railway cuts off that part of the Nile known as the Second Cataract, where the rocks and rapids make navigation dangerous and slow, even for barges of the lightest draught. Meanwhile a navigable channel has been marked out up to Akasheh in anticipation of the speedy rise of the river, and by the combined efforts of camel, railway and river transportation, it is expected that a large store of supplies will quickly be gathered at Akasheh. This will form the outpost of the Egyptian army until next September or October, when a general advance will probably be made in the direction of Dongola. If the advance party of this expedition should not be opposed by any large gathering of the enemy, it is probable that it will reach Dongola before the close of the year. In any event, it is likely that Akasheh will be made a permanent stronghold of the Egyptian army, which can at any time be used as the basis for an expedition to recover the Nubian territory to Egypt. Whether the English government contemplate a joint invasion of the Soudan by a numerous army of British and native troops, or whether the work of subjugating the Mahdists is to be carried out by a gradual extension of the Egyptian outposts, remains to be seen. The question is of very vital importance to the welfare of Egypt in general and of the Soudan in particular; and it is at the present moment of all-absorbing interest in Cairo and Alexandria, whose markets would be greatly benefited if the former profitable connections with the Soudan could be re-established.



THE NILE EXPEDITION—EGYPTIAN CAVALRY ON THE MARCH.

We are indebted for our illustrations to the Illustrated London News.

THE LARGEST ARMOR PLATE EVER TESTED.

CAPT. SAMPSON, Prof. Alger, and other officials of the Bureau of Ordnance, witnessed an attack by a 10 inch gun on a 15 inch armor plate at the Bethlehem Iron Company's proving grounds, at Bethlehem, Pa., on May 5. The plate weighed 38 tons and was the largest one ever shot at.

The plate tested represented the group of plates for the turrets of the battle ship Iowa. It was 17 feet

wide, 9 feet high, and 15 inches thick. A Carpenter projectile, weighing 500 pounds, was fired from a 10 inch gun with a charge of 154 pounds of powder. The point of impact was a little to the left and below the center of the plate. The projectile was shattered, and the point embedded and welded in the plate. The plate was split across its width, while there was a crack to the bottom. The manner in which the plate cracked was strange, as there were no radiating cracks from the point of impact.

The result was not an entire surprise, for the plate was originally rejected on account of flaws noticed in one end. The company had confidence that the plate would stand the test, however, and decided to fire at it. The cracking of the plate was caused by the opening of internal flaws known to have existed previously. Under the circumstances, the ordnance officials did not consider it advisable to continue the test. The company will be permitted to present another plate to be tested.

THE NILE EXPEDITION—CAVALRY HORSES PICKETED.

DISCUSSING THE NILE EXPEDITION IN THE MOSQUE OF EL-AZHOR, CAIRO.

SOME CURIOUS FACTS IN PLANT DISTRIBUTION.

By W. BOTTING HEMSLEY, F.R.S., in Knowledge.

THE present distribution of plants, apart from those low in the scale of organisms, exhibits some very curious phenomena. Perhaps those most obvious to the majority of persons are consequent upon the spread of European peoples over other parts of the globe. The domestic weeds of ancient civilization, the roadside weeds and the cornfield weeds have accompanied man in his most distant wanderings, and in many instances have developed increased vigor and a power of colonization unsurpassed by man himself. In some instances the reproduction and spread of these weeds is so rapid as to become a great scourge to agriculture, overrunning and destroying crops almost as effectually as swarms of locusts; and laws have been framed making it compulsory on farmers to keep their land free of these prolific strangers. Sometimes it is a new weed that makes its appearance and propagates itself in this extraordinary manner, advancing from field to field, farm to farm, county to county, and State to State, at an incredible pace.

During the last three or four years the so-called Russian thistle (Salsola Kali, var. Tragus) has been occupying the serious attention of the farmers and legislators of the Eastern and Central States of North America, and it is already the subject of a considerable literature. Thousands of square miles are infested and the loss resulting therefrom in 1892 was estimated to exceed two million dollars!

But the object of this article is to direct attention to some of the phenomena of the distribution and existence of plants in nature, uninfluenced and unaffected by man, either directly or indirectly—that is to say, to the latitudinal limits, the altitudinal limits and other interesting facts of the present distribution of flowering plants.

In the highest latitudes yet reached in the west, in Ellesmere Land and Grinnell Land, between 80° and 83° 6′ north latitude, the ground in localities the most favorable to the development of vegetation is carpeted with plants, many of them having brilliantly colored flowers, produced in great profusion during the short but continuous summer that there obtains. About seventy species were collected within the latitudes named by the naturalists of the last British polar expedition, and they included such familiar showy plants as Papaver alpinum, Silene acaulis, Dryas octopetala, Saxifraga oppositifolia and Epilobium latifolium.

The Austrians found a very different condition of things in the same latitudes in Franz Josef Land, eastward of Spitzbergen. Plants were found, and of the same species, but in an extremely stunted state, with scarcely a flower to be seen, and nowhere was there continuous vegetation a few square feet in extent.

In these very high latitudes seed is rarely, if ever, perfected, and plants increase only by vegetative development—suckers, underground stems and trailing rooting stems. Yet the greatest cold experienced—upward of one hundred degrees (Fahrenheit) of frost—did not impair the vitality of wheat that had been fully exposed for four winters and four summers. It should be mentioned that none of the plants inhabiting these high latitudes are peculiar to the region; that very few species are confined to the Arctic regions; and that many of them are widely spread in Alpine regions of lower latitudes, some even recurring on the mountains within the tropics, and a few reaching the southern limits of vegetation.

In the southern hemisphere there are now no flowering (phanerogamic) plants growing within thirty-five degrees of the Pole,* and countries in as high a latitude as Scotland are absolutely ice bound. South Georgia, in the American region, and Macquarie Island, in the New Zealand region, may serve to illustrate the Antarctic flora and the southern limits of flowering plants.

They are small islands of comparatively slight elevation, and both situated in 54° south latitude. South Georgia is about a thousand miles east of Cape Horn, and nearly as far from the Falkland Islands, the nearest land, except some very small islands concerning the vegetation of which nothing is known.

Its exceedingly meager flora has probably been exhaustively investigated, and the result is a list of thirteen species of flowering plants and no ferns. Not one of these species is peculiar to the island, and nine out of the thirteen inhabit both the American and the Australasian or New Zealand regions.

When we remember that the Antarctic flora now exists only in such isolated and distant fragments, we are hardly prepared to find almost the same homogeneity as in the north, where there is practically a continuity of land. Yet so it is; and the only satisfactory solution of the problem is a former greater land connection and continuous flora, probably in higher latitudes than the existing fragments. One of the tasks of Antarctic explorers is to search for fossil remains which might give a clew to the history of plant life under different conditions.

A noteworthy feature in the small flora of South Georgia is the presence of three northern plants, namely, Montia fontana, Callitriche verna and Phleum alpinum. Two out of three of these plants are also found in the New Zealand region. As previously mentioned, some northern species extend into the southern hemisphere, but no essentially Antarctic types extend into the northern. The farthest they reach are the Alps of Victoria and the Andes of South America, where a very few outliers occur.

Another peculiarity of the highest Antarctic flora is the almost total absence of color in the flowers, which

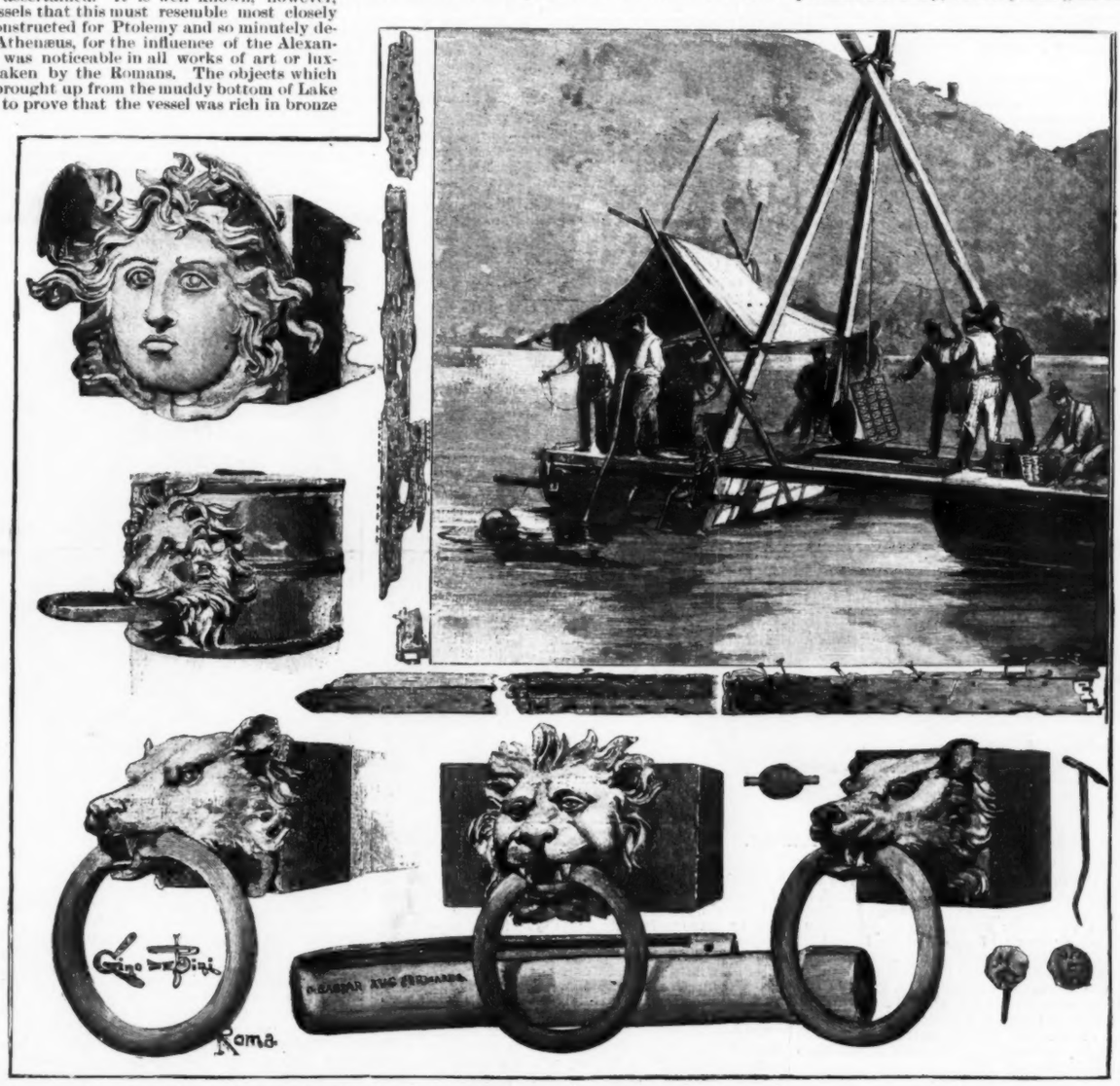
* Should there be no error in locality, there is a single known exception. In the Kew Herbarium is a specimen of a grass (Aira antarctica) labeled "New South Shetland, Dr. Eights."

e, moreover, exceedingly small. Butterflies and bees e also absent, whereas they abound in the north, here showy flowers are found.

The flora of Macquarie Island, on the opposite side the world from South Georgia, although very poor, d possessing no endemic element worth mentioning, esents more striking features. For example, there me very showy plant allied to the Michaelmas daies, and another, Stilbocarpa polaris, belonging to e same family as the ivy, having very large and ndome leaves. Yet, although the climate is much s rigorous than in South Georgia, there is no shrub- plant of larger dimensions than common thyme, d the whole flora consists of less than thirty spe- s. Comparisons with other islands I must leave for uture article.

N OLD ROMAN VESSEL IN LAKE NEMI.

THE news of the finding of an old Roman vessel on the ttom of the far famed Lake Nemi, in the Alban Mountins, near Rome, has aroused much interest all over e world, and it has been hoped that a pretty good idea the form and arrangement of this vessel, which was t about 1800 years ago, could be obtained, but this pectation has not yet been realized, nor has the me of the emperor for whom this grand galley was ilt been ascertained. It is well known, however, at the vessels that this must resemble most closely e those constructed for Ptolemy and so minutely deribed by Athenæus, for the influence of the Alexanian court was noticeable in all works of art or luxy undertaken by the Romans. The objects which ve been brought up from the muddy bottom of Lake mi seem to prove that the vessel was rich in bronze



OLD ROMAN VESSEL FOUND ON THE BOTTOM OF LAKE NEMI.—ORIGINAL DRAWING BY GINO DE BINI.

naments. Some of these, as will be seen from the companying engravings, for which we are indebted the Illustrirte Zeitung, are of a purely decorative ature, while others met a practical need; such, for inance, was the ring held in the mouth of the lion's ask. This was fastened on the edge of the boat, and ere seems to be no doubt that it was used in securg the latter to the shore or to an anchor by means of rope.

THE CHEMICAL LABORATORIES OF GERMANY.*

By Prof. A. B. PRESCOTT, University of Michigan.

IN the increase of chemical science it is evident that ermany is, and has been for a generation or more, e most productive country in the world. Her conbutions to the common stock are and have been the ost abundant. This is not to say that Germany nds the other countries at all points.

Of a truth the world is one in chemistry as it is in y other branch of learning. The working literature the investigating chemist in any country is inadeate if it does not contain, besides the publications Germany, those of England and the United States, rance and Italy, Austria, Holland, and other na-

* The Phi Chi Communicator.

tions—embodying the communications from laboratories in all countries of civilization. If you set out by course of chemical work to find an answer to any unsettled question, however new and untried your project of work may seem to be, the library will probably reveal that some one in some laboratory, not always in Germany, has either furthered or forestalled your modest effort. The chemists of the Continent say with emphasis that they must read English, and must have the publications of both England and America. If we are looking for the unification of mankind, we find it in the literature of the investigator. So the chemical library of this university, in nine out of ten of its volumes, is identical with the chemical library of a university in Germany or in Switzerland.

AMERICANS AT GERMAN UNIVERSITIES.

The German universities, it is well known, are strongly attractive to the graduate students of the whole world, especially to those countries beyond the Continent, and perhaps most to those of the United States. Among the causes of the attraction we may name their freedom of study, permitting concentration of labor upon the leading subject; their organization for research by the student, under the direction of a professor; their repute for large scientific production, and the eminence of their professors. In what sense laboratories are, in themselves, the attraction to students in the sciences, will appear as we go on. Twelve of the more attractive universities, with five polytechnic schools, registered last year 373 students from the United States at one time. Sixteen per cent. of these, or 59 Americans, took chemistry as a leading study. About half as many, or 8 per cent. of all, were registered for biological or natural sciences as the major study. In philosophy there were nearly as many as in chemistry—indeed there were more if the polytechnic schools are included.* Medicine obtained the highest American number,† 75; chemistry the next highest, 59; philosophy, 51; theology, 18; law, 8.

Again, we find the students from the United States, in ratio to the students from Germany and all other countries, number as 1 to 65, for the 17 before mentioned centers of study. The United States sent to Germany about two and one-half times as many students as Great Britain does. Of the English students fully one-half are in chemistry, yet these are a third less numerous than the Americans in the same subject. Japan and the other Asiatic countries had last year only 45 students in the above mentioned German universities—perhaps fewer than there were from the same countries in American universities. Among the 4,735 university students at Berlin, France sends 3; Russia, 154; America, 147.

* In the twelve universities there were 51 Americans in philosophy against 39 in chemistry.

† If Vienna were included, the number in medicine would be proportionately increased.

STUDENT PARTISANSHIP.

In a German university, among students working together in any subject, there are sure to be many men who have worked in the same subject in other universities. They canvass freely, one with another, the qualities, methods and characteristics of the professors under whom they have elsewhere worked, and recount the college history of this subject, in its educational bearings, as gained at first, second or third hand from the chief universities of the empire. With more or less warmth of partisanship the men contest with each other for their individual preferences among universities and professors all over the Continent, yet chiefly within the confines of this leading subject to which they are all devoted. They are somewhat indifferent to the teachers of other branches; they have the lighter pleasantry about personalities in the faculty, as the men have in other countries; but as regards the various university leaders in their own subject, they are always ready to speak with candor, and often with zeal. Therewith frequently appears a zealous discussion of methods, theories, and procedures, not without partisan obstinacy, but all yielding an endless fund of information concerning what is done in the several centers of study, and the authorities as they are known to be.

Each chemical laboratory is known for its director in person; for its "ausserordentlieh" professors, and "privatdocenten," severally and in a body; for the efficiency and working excellence of the building and its appliances; and for the general repute of the university to which it belongs. Each chemical laboratory is valued for the standing and helpfulness of those who direct the "arbeiten" for graduation, and for the interest of lectures given there.

LECTURES AND LABORATORIES.

In most universities the director gives the cardinal course of lectures, five times or even six times a week, through both semesters, covering the inorganic and organic parts of the subject, in one class for all those in chemistry, in pharmacy and in medicine.

In Berlin, however, the director of the second laboratory lectures upon inorganic chemistry when the director of the first laboratory lectures upon organic; at Leipsic the director of the second laboratory lectures upon physical chemistry and special topics; and at Freiberg the fundamental lectures are given by an associate professor, while the director does not lecture at all.

In the main course of lectures there is therefore a

large number of hearers. Each student puts his card upon his seat, and there are not many absentees. The lecture room is in the chemical building, is finely provided for experimental illustration, and this daily lecture is a sort of central public event for all the laboratory. In most of the universities the main course of lectures is taken but once as a course by the chemical students, though the course of Victor Meyer is usually taken as many times as the student of chemistry remains years at Heidelberg.

AUSGEWAHLTE CAPITEL.

Besides this main course of lectures, daily, by the director, there are very numerous chemical lecture courses on chosen chapters, ausgewaehlte Capitel, and divers special topics, taken anywhere from one border of chemical science to another, these lectures being once or twice or three times a week elected by a small number of the advanced workers, sometimes less than six, and sometimes more than ten in number, each course being offered by a privatdocent, or an associate professor. Sometimes such a course is given by the professor in charge. Thus Dr. Friedheim gives a one hour course on "Constitution of Inorganic Compounds," Prof. Schneider a one hour course on "Bismuth," Dr. Wohl a two hour course on "Carbohydrates," Dr. Rimbach a one hour course on "Optical Methods in Chemistry," Prof. Pinner a one hour course on "Chosen Chapters in Pharmacy," Dr. Anwers a two hour course on "Stereo-chemistry," Dr. Behrend a two hour course on "Pyridine, Quinoline and Thiophene."

QUIZZES.

A colloquium, or review quiz, once or twice a week, is here and there announced, as a course separate from the lectures. It is intended for advanced students, and usually taken by those preparing for examination; often the class consists of six or eight members. On qualitative analysis, which, as a rule, is the first course in laboratory work, but few lectures are offered, and fewer taken, and quizzes are given by appointment in various ways. The same is true of quantitative analysis, except that the volumetric work is more often the subject of a short lecture course. Class room drill, or regular recitation, has no place in the German university system; and from this want, in my judgment, the early laboratory work of the chemical student suffers largely. Not much is expected of the student's first year in the subject that is to be his major study, nor at all of the German student's first year at the university. It is otherwise with a graduate student from America, who has worked through the beginning of his leading study, and who is, moreover, so well used to freedom in his work as not to be at a loss when he becomes his own master.

LEADING TEACHERS.

It is sometimes remarked by students in the German laboratories that their most eminent chemists, name in order of seniority, are Von Baeyer, at Munich; Victor Meyer, at Heidelberg; and Emil Fischer, at Berlin. From this opinion I should hardly dissent, but I would add other names of nearly equal interest. At Leipsic the honored Wislicenus deserves the fullest admiration; and Ostwald is in physical chemistry the most prolific, and certainly the most quoted authority at the present time. Kekule is still at Bonn, in the same laboratory that astonished the chemical world by its beauty when it was built (in 1864), and where he put forth the theory of closed atomic chains, which has been a guide in one-third of all the chemical work done ever since. Claus, of Freiberg, reports a great deal of work in a very interesting field, filling no small portion of the Journal fur praktische Chemie. Fittig, of Strassburg, has given a great deal to chemistry. In organic pharmaceutical chemistry E. Schmidt, of Marburg, is prolific in work of exceeding interest. These are doubtless the best known chemists in their several institutions, but there are other universities whose laboratories of chemistry require attention.

THE FINEST LABORATORY BUILDING IN EUROPE.

The best chemical laboratory building in Europe at present is that at Zurich, Switzerland, completed eight years ago. The laboratory at Strassburg, built a little earlier, and that at Heidelberg, built later, rank next, being buildings of nearly equal excellence. The laboratory at Gottingen is also new, and is, I believe, a fine building.* The Zurich laboratory cost, Prof. Lunge told me, 1,750,000 francs ($350,000). It is on a commanding site, with plenty of open space around it. There is a curious connection of personal history with these four recent laboratories, which runs as follows: Shortly after Fittig's laboratory was built at Strassburg, Victor Meyer and George Lunge, who were together as chemical professors in Zurich, shaped the architect's plan for the Zurich laboratory. The new building at Zurich was made to agree in some outline features with its neighbor at Strassburg, but was made a good deal larger and more elegant. Before the Zurich building was done, Victor Meyer accepted a call to Gottingen, to succeed the celebrated Wohler; and here a new laboratory was built for him with great enthusiasm. It was no sooner done, however, than Prof. Meyer yielded to a call to Heidelberg, to succeed Von Bunsen, on condition that a new laboratory be put up at once. Gottingen did not condone his desertion. He clung, however, to the third new laboratory he had undertaken within three or four years, and Heidelberg hopes he will stay. In this last instance, however, the old laboratory of Bunsen was not removed. It remains as I first saw it in 1872, filling the corner of the city block on both streets, and completely hiding from view the new building, which stands in the center of the block, and is connected with the old structure by corridors. In any one of these three laboratories at Strassburg, at Zurich or at Heidelberg, the spacious workrooms, the generous appointments for operations in all branches of chemistry, and the substantial construction in goodly proportions throughout, were a delight to my eye whenever I entered them.

(To be continued.)

* The chemical laboratory of the polytechnic school at Aix-la-Chapelle ought to be included in this comparison.

NASR-ED-DIN, THE LATE SHAH OF PERSIA.

SIXTY-SEVEN years ago, in a small village near Tabriz, in the northwestern corner of the Persian empire, was born the late Shah of Persia, Nasr-ed-Din (the light of the world). If his career had not been summarily cut short by the hand of the assassin, he would very shortly have celebrated his jubilee; as it was he reigned forty-eight years, having succeeded his father Mohammed Shah in the year 1848. He was the fourth ruler of what is known as the Karjar dynasty, which dates from the year 1794, when Agha Mohammed, of Turkish blood, was established upon the throne at the close of a civil war of long duration.

THE LATE SHAH OF PERSIA.

MUZAFER-ED-DIN, THE PRESENT SHAH.

The early years of the late Shah were passed in obscurity and neglect. Both his mother and himself were disliked by his father, who up to the hour of his death intended to put somebody else in the place of the legitimate heir as his successor.

At the death of the old king, which occurred on October 15, 1848, the Russian consul-general immediately rode in person to Tabriz to acquaint the young prince and rightful heir of his father's death, who, upon receipt of the news, at once set out to secure the throne. In this he was aided by the influence of the Russian consul and by the Ameer Mirza Taghi, who devoted his large private wealth to the interests of Nasr-ed-Din. Fortune favored the young prince, who was but eighteen years old, and after a fierce civil war he successfully fought his way to the throne. His friend Mirza Taghi was appointed grand vizier, and together they set out to suppress the rebellion and reform many of the abuses which had been encouraged by the late Shah.

The crown of Persia must have sat heavily upon the boy monarch in those early days of his reign; for it must be remembered that he had been brought up in absolute ignorance and neglect. "But eighteen years of age, of a build angular and lank at the time, with an education so neglected that he could not even speak the language of the country which he was to rule, and knew next to nothing of its resources, administration and history, it is a remarkable fact that, all these things considered, quite a decent and able king was gradually shaped out of this unpromising raw material.

"For a year or more Ameer Mirza Taghi gave his young lord daily lessons in the Persian language, in literature, writing, and especially in manners and the complicated code of etiquette. The Shah never completely overcame the disadvantages of his youth. His voice sounded harsh and abrupt, his Persian had a foreign sound and he practiced regularly at writing the different Persian characters. His manners lacked charm and elegance, yet he bore himself with dignity."

The Shah of Persia is possessed of a power even more absolute than that of the Czar of Russia. He has supreme control of both the person and property of his subjects, and also of the public revenues. It would appear that, for an Oriental monarch, the late Shah used the vast powers at his command with temperance and a measure of benevolence. He ruled with a firm hand, it is true, and there were at times outbursts of truly Oriental rage and vindictiveness, in the course of which he was guilty of acts of barbarous cruelty; but, taken altogether, his reign gives abundant evidence that he wished to reform the abuses of his predecessors, and sought to lift his country out of its political and social degradation. He was possessed of natural ability and more than ordinary intelligence. His ideas were progressive, and he sought to introduce many of the advantages of civilization which he became acquainted with in his foreign travels.

The Shah was a well-known personage in Europe, which he visited on three occasions. His first visit was made in 1873, and he came again in 1879. His last visit was made in 1889, when it was noticed that he had lost but few of these peculiar habits which led to many comical situations when he was the guest of the various European courts.

It was stated, for instance, that at the time of his visit to England it was his custom to throw his plates beneath the table as soon as he had finished with their contents. This entailed a loss upon the entertainer which might have been bearable had the ware been of ordinary pattern and value; but "in a European palace, with China as fragile as egg shells, and worth its weight in gold," this idiosyncrasy of the guest must have been acutely exasperating. Another story, which went the round of the press at the time, and was generally credited, shows that his conversation was as erratic, and certainly not less inconvenient, than his table manners. It is to the effect that during a conversation with a nobleman of distinction he abruptly asked, "Is that your wife over there?" "Yes, your majesty," was the reply. "But she is old and ugly. Why don't you get rid of her and take a new one, one of these young and pretty women?"

The friendship of Persia has always been solicited by both Russia and England, and especially of late years, when the interests of these two powers have been developing a keen competition for Asiatic predominance. The Russian influence in assisting the Shah's struggle for the throne, above related, won for that country the early friendship of the Persian monarch. When the war between Russia and Turkey broke out in 1853, he remained neutral. When Herat was occupied jointly by Russian and Persian troops, England declared war against the Shah, and after a short campaign a treaty was signed which gave the British all they asked for. For the past twenty-five years, or since the Shah's first visit, he has been distinctly friendly to the English government, who have done all in their power to cement the union, on account of the important strategic position which the Shah's dominions would occupy in the event of the oft discussed war between England and Russia.

The late Shah is succeeded by his second son, Muzafer-ed-Din, who has been crowned at Tabriz. He has retained in office the Grand Vizier Amin-es-Sultan, and his accession to the throne has been received with public approval. The new Shah was recognized as heir to the throne as far back as 1858, his elder brother being shut out from the succession by the fact that his mother was not of the royal tribe of Kajar. He is now forty-three years of age. By virtue of his being heir to the throne, he has held the office of governor-general of the province of Azerbaijan. He is described as being "a tall, strongly-built man, and a keen sportsman." It augurs well for his future rule that he is very popular in the province of which he was governor.

THE GIGANTIC BIRDS OF SOUTHERN PATAGONIA.

OUR readers have perhaps not forgotten the restoration of the æpyornis by Mr. Oustalet which we published not long ago. We now propose to discuss, says La Nature, some other extinct birds, more monstrous still, whose fossil remains have recently been discovered in the tertiary strata of Southern Patagonia.

These great birds, like those of Madagascar and New Zealand, were incapable of flying, but they differed much in their organization from the dinornis and æpyornis. The latter, like the ostriches and cassowaries, had a head and bill relatively small for their size. The gigantic birds of Patagonia had, on the contrary, a huge and strongly hooked bill (a true vulture's bill), so much so that they might lay better claim than the æpyornis to be identified with the celebrated roc of the Arabian Nights, if it could be admitted for an instant that the authors of those legends had seen anything of this fabulous bird but the eggs, which are undoubtedly those of the æpyornis.

The geological strata from which Messrs. Carlos and Florentino Ameghino obtained these curious debris are the most ancient of the tertiary series in Patagonia. This region is now a desert, devoid of arborescent vegetation, and so destitute of water that explorers are forced to go to seek this precious liquid at a distance of twenty leagues and to carry it upon muleback. The landscape, as in all Southern Patagonia, is, despite the absence of forests, very picturesque by reason of its broken aspect, which makes it resemble a country in ruins. Everything indicates that this country was, at a former epoch, deeply furrowed by water that flowed toward the sea, in consequence of an uplifting of the land that exposed the strata which contained the fossils under consideration.

These strata are probably of the Eocene epoch and are called Pytherium, from the name of a large herbivorous mammal whose remains are found in abundance in the sandy and friable soil of this now dried up region. As in the Bad Lands of the Western Territories of the United States, it is not necessary to excavate the earth to a depth in order to find fossils, for the bones of large extinct animals are often found exposed upon the side of the declivities that border the road followed by travelers, and offer an easy booty to the paleontologist who may know their value and who for the first time travels over this wild country.

It was thus that Mr. Ameghino was enabled to collect the valuable remains that permitted of reconstructing a fauna that long ago disappeared. Some crania, some broken bills, some wing bones and some legs, often almost intact, give us an idea of the strength and proportions of these great birds. More than fifteen species of various sizes have been described.

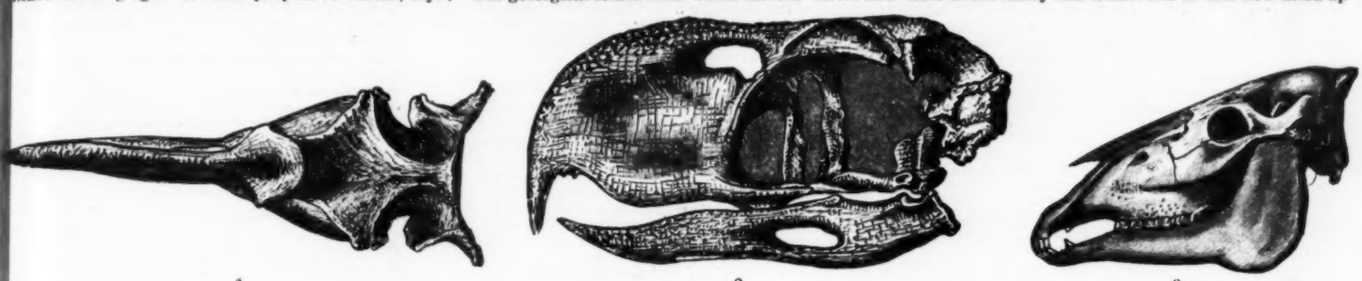


FIG. 1.—SKULL OF THE PHORORHACOS LONGISSIMUS SEEN FROM ABOVE (1) AND LATERALLY (2), AND REDUCED TO ONE-EIGHTH NATURAL SIZE. 3. SKULL OF A HORSE ON THE SAME SCALE.

The Phororhacos inflatus is the best known species. Of this we have an entire skull, with its lower mandible, the bones of the legs and wings, the pelvis and some of the vertabræ of the neck and tail. Although it is not the largest species, it merits a few words, since a study of its characters gives us quite a clear idea of its organization and habits.

The bill is remarkably thick vertically and very much compressed laterally, like that of the rapacious birds. The hollow that precedes this hook presents two small teeth. If we compare this bill with that of our present birds, we shall have to set aside the vultures and other rapacious birds, all of which have well developed wings, and also the balœniceps and the caneroma, whose wide and depressed bill resembles that of the phororhacos only in the terminal hook. But there is one bird not long extinct that exhibits undoubted affinities with the latter, at least by the form of its bill; we refer to the Didus ineptus, a large bird incapable of flight, which was still living on Mauritius Island during the course of the seventeenth century. This bird attained the size of a swan, but was of much heavier build. It is said that it fed upon vegetable substances, such as fruits and roots. It was a stupid animal and a poor runner, and this explains its rapid destruction, beginning from the time at which the Mascarene Islands were occupied by the Dutch in 1598. Less than a century afterward the species was completely extinct.

Although the phororhacos resembled the didus in its bill, it differed from the latter in the form of the pelvis, which was much narrower than that of the didus, and which indicates a lighter bird. In this respect the phororhacos more closely resembled the aphanapteryx or "snipe-billed red hen," which lived on Mauritius Island at the same epoch as the didus, and which, like it, is extinct. The aphanapteryx belonged to the group of rails and had an affinity especially with the oeydromes of New Zealand. Its bill resembled that of the courli and the ibis, and its size was less than that of the didus.

The skull of the phororhacos is 14 inches in length, while that of the didus is but 10. A comparison of the limbs proves that the form of the phororhacos was not so squat as that of the didus, and was more comparable to that of the aphanapteryx. The measurements of the leg of the didus are as follows: femur, 6·5 inches; tibia, 9·5 inches; tarsus, 5·5 inches; altogether, 21·5 inches for the entire limb; while the phororhacos' leg measured as follows: femur, 9 inches; tibia, 16 inches; tarsus, 12 inches; in all, 37 inches.

The sternum of the phororhacos is not known, so that it is impossible to say whether it was carinate like that of the didus, as seems probable, or flat and shield-shaped like that of the æpyornis. The feet have four toes, as in the didus, and the caudal vertebræ come to a point, as in the reptiles, instead of terminating in a tubercle giving attachment to the powerful muscles of the tail in all the birds that have this organ well developed. The bones of the phororhacos did not possess any cavities filled with air, but were filled with marrow like those of mammals. The bird was of an imposing stature and was comparable to the ostrich, but more robust. Another species of the same genus, the P. longissimus, reached greater dimensions.

The skull of the last named species was 26 inches in length, a size that that of few mammals reaches at the present epoch. The skulls of the horse, camel, and giraffe are much inferior in this respect. It was, says Mr. Ameghino, the most formidable bird's head that could be imagined. The form is that of the preceding species, but with proportions a third larger. The bones of the leg indicate an animal little inferior to the Aepyornis ingens. The leg bones of the latter, according to Mr. Oustalet, measured as follows: femur, 13 inches; tibia, 25·5 inches; metatarsus, 16·75 inches; say altogether, a leg about 55 inches in length. These measurements are approximate and are based upon a comparison of the bones, partly broken, with those of the preceding species. The toes, of which all the phalanges are known, are extremely large, that of the center being more than 10 inches in length, and its ungual phalanx alone measuring 2·5 inches in a straight

FIG. 2.—RESTORATION OF THE BRONTORNIS BURMEISTERI.

The bird is represented as attacking a dinosaur (Hadrosaurus), which is seeking refuge in a swamp. A Phororhacos longissimus is shown at the upper left hand side of the engraving.

line. This is strongly curved and pointed, and the basilar tubercle forming a heel is greatly developed—characters that are found again in the dídus, and indicate a poorer runner than the æpyornis and the dinornis.

If the phororhacos cedes a little, as to stature, to the æpyornis, the Brontornis Burmeisteri, of which it remains for us to speak, was certainly the most colossal of all the birds known. It was much more massive in build than the phororhacos. The bill, while possessing the same form, was shorter, wider and thicker vertically. The leg was really monstrous, as is shown by the following dimensions: femur, 16 inches; tibia, 30 inches; metatarsus, 17 inches; in all, 63 inches for the height of the haunch, say 9·5 inches more than the Aepyornis ingens. This bird must have been more than 13 feet in height. The shaft of the femur was 3 inches in diameter and the head of this bone measured no less than 7 inches. The toes were shorter and more massive than those of the phororhacos and the ungual phalanges were much wider, flatter and less pointed, like those of running birds. The ungual phalanx of the median toe was 2·5 inches long and 2 inches wide at the base. These characters indicate habits somewhat different from those of the phororhacos. What were the habits of these large birds, so remarkable by reason of their strong hooked bill, so different from the short and conical bill that characterizes the æpyornis and dinornis? We know that the diet of the latter was almost exclusively vegetable, like that of the ostriches and cassowaries, but, when it concerns the phororhacoses and the brontornises, it is difficult to admit that this powerful bill could have served only for pulling up roots and breaking branches of trees.

It is asserted that the didus fed upon plants solely, but the habits of this so quickly exterminated bird are scarcely known to us except from the stories of sailors, who are ignorant and but slightly observant of things relating to nature. It is more probable that this large bird was omnivorous and fed indifferently upon fruits, roots, mollusks and reptiles.

Such must also have been the diet of the wingless birds of Patagonia, several species of which do not exceed our swans or the marabouts of Calcutta in size. What confirms this hypothesis is that Mr. Ameghino has found upon the skull and bill of the phororhacoses certain exostoses and distortions that can be nothing but the trace of deep wounds cicatrized by a deformed callosity. These birds, says Mr. Ameghino, were true ferocious beasts that engaged in frequent battles. It may be admitted, too, that these powerful bipeds did not fear to measure their strength with reptiles of large size.

The paleontological researches made by Messrs. Ameghino and Moreno teach us that, at the end of the cretaceous epoch, the reptiles, and especially the dinosaurians, were abundant and varied in the south of Patagonia. Mr. R. Lydekker has described their remains under the names of titanosaurus and argyrosaurus. It is even probable that this point of the globe is the last in which these gigantic reptiles, so flourishing in the jurassic epoch, had representatives before becoming extinct forever. Like the baleniceps of the present epoch, which destroys many young crocodiles upon the banks of the White Nile, and like the serpentary of southern Africa, which makes bloody war upon snakes, and which is the only running rapacious bird known, the phororhacoses must have given chase to reptiles, which their long legs allowed them to pursue into the swamps. Seizing such reptiles with their strong claws, they must have killed them with strokes of their bills in order to devour them afterward at their leisure, when another bird of their own species did not come to dispute such prey with them. The brontornis must have preferred dry ground, as is shown by the conformation of its toes, the nails of which must have become worn by walking, as in the case of the ostrich.

If we suppose that these large birds already existed in the cretaceous epoch, as seems probable, it is not rash to believe that the phororhacoses and the brontornises did not remain strangers to the extinction of the dinosaurians of Patagonia.

COMPARATIVE EXPOSURES FOR LANTERN SLIDES BY CONTACT AND REDUCTION.

By Rev. G. T. W. PURCHAS, B.A.

AMONG the numerous photographers who usually make their lantern slides by reduction from negatives of a larger size, there must, I believe, be many who like myself have often wished for information as to the exposure required as compared with the exposure in the case of a slide exposed in contact with the negative. Most makers of plates give the exposure required in the latter case, when artificial light is used, such as ordinary gas or lamplight, but I am not aware of any maker who gives the exposure required when reducing in the camera and using artificial light. One reason for this no doubt is the fact that when reducing by means of a lens many factors have to be taken into consideration, namely, the ratio of reduction, the stop used, the density of the negative, the rapidity of the plate, and the distance of the source of artificial light from the negative; whereas, in the case of a slide made by contact, only the three factors last named have to be considered.

But since enlargements are frequently made by artificial light as well as direct prints on bromide paper, it appears to me that an examination of the connection between the exposures in the two cases would probably be of interest to many amateur photographers besides myself. It is true that there is one great drawback to the use of artificial light for making lantern slides by reduction, namely, the length of exposure required, but, on account of the variation in the actinic power of daylight in this climate and the constancy of the actinic power of artificial light, there are very considerable compensating advantages, especially if one slide is developed while the next one is being exposed. Many, moreover, are more at liberty in the evenings, and would therefore be glad to be able to use artificial light for making slides.

I have therefore been at some pains to reason out the connection between the exposures in the two cases of a print by reduction and one by contact, and though mathematical terms are necessary, I have endeavored to make the results of the calculation intelligible even to those who have no mathematical knowledge. With this introduction I will proceed to the calculation.

Let I denote the intrinsic brightness of a small part of the negative. Let a denote the area of this small part, and let b denote the area of the corresponding image formed by the lens on the plate. Let c be the distance of the negative from the optical center of the lens, and d the distance of the image on the plate from this point. Let e be the ratio of reduction in linear dimensions, so that

$$e = \frac{c}{d} \text{ and } \frac{a}{b} = \frac{c^2}{d^2} = e^2.$$

Let f be the equivalent focal length of lens, and $\frac{f}{g}$ the diameter of the stop used. Lastly, let E denote the exposure required for a slide by contact, the illumination of the negative being supposed the same as in the case of making the slide by reduction. Then, by well known laws of optics,

$$c = (e + 1)\, f, \text{ and } d = \frac{e+1}{e} \cdot f.$$

Now the area of aperture of stop

$$= \left(\frac{f}{2g}\right)^2 . \pi.$$

If we assume that the aperture of the diaphragm receives light directly from the negative, then the amount of light passing through the stop from the area a of the negative will be

$$I . \left(\frac{f}{2g}\right)^2 . \pi . \frac{a}{c^2} = I . \frac{a . \pi}{(e+1)^2 . 4g^2}$$

But this light is distributed over the area b of the plate, and therefore the intrinsic brightness of the small area b will be

$$I . \frac{\pi}{4(e+1)^2 . g^2} . \frac{a}{b} = I . \frac{\pi}{4(e+1)^2 . g^2} . \frac{c^2}{d^2} = I . \frac{\pi . e^2}{4(e+1)^2 . g^2}$$

Now this expression will be true for all small areas of the negative and of the image, and it is clear that the exposure will be inversely proportional to the intrinsic brightness.

Therefore the exposure for the slide by reduction

$$= E . \frac{4 . g^2}{\pi} \left(\frac{e+1}{e}\right)^2$$

Take the value of π as $\frac{22}{7}$, and we have exposure by reduction

$$= E . \frac{14 . g^2}{11} \left(\frac{e+1}{e}\right)^2$$

Probably the most ordinary case is that in which a lantern slide is reduced from a half plate negative, so that the longer side of the picture is reduced to fall within the side of a lantern plate. In this case the picture will be reduced to half its linear dimensions, and therefore e = 2.

If we suppose the stop used to be f/16, then g = 16, and the exposure by reduction is found to be 733 times the exposure necessary for a slide by contact, or, to put the matter more simply still, for every second of exposure required for a slide made in contact with the negative, rather more than twelve minutes would be required when the slide was being made by reduction to half size in linear measurement, the stop used being f/16. The exposure required in the case of other stops may, of course, be readily calculated on the same principle as for ordinary photographic exposures.

The exposure required for an enlargement may be calculated from the same formula, only remembering that in this case e will be a fraction, since it is the ratio of the length of the side of the negative to the length of the corresponding side of the image. If, therefore, we know the exposure required for a print by contact on bromide paper, we can at once find the exposure for an enlargement on the same kind of paper, or since, as a rule, slow paper is used for contact prints and rapid paper for enlargements, we can find the exposure for an enlargement on rapid paper if we know the comparative rapidities of the two papers.

In the same way, working backward, we can, if we know the exposure for an enlargement, find also the exposure for a print by contact, and thus use up any small pieces of enlarging paper by making direct prints.

The only point in the above calculation which appears to me at all open to question is the assumption that I have made that we may neglect the effect of the front lens of a rapid rectilinear combination in calculating the amount of light which will pass through the aperture of the diaphragm, but a little consideration will, I think, show that this is a justifiable assumption, because a single landscape lens which has the stop in front of the lens is found to have the same rapidity as a rapid rectilinear with an aperture bearing the same relation to the focal length. In fact the slight loss of light in the second case through having more reflecting surfaces is counteracted by the slightly greater amount of light which passes through the diaphragm owing to the rays of light being refracted by the front lens.—The Amateur Photographer.

PURIFYING BLACK LEAD.—Following are four processes which have recently been patented for effecting the purification of black lead, with a view to removing iron and other impurities and obtaining the resulting product in a fine state of division: (a) Pulverized black lead is moistened with concentrated nitric or sulphuric acid, or both. It is next washed till the wash water is free from acid, and then calcined. (b) The black lead may be heated with a solution of bichromate or permanganate of potash and acid, and subsequently calcined. (c) Brodie's process may be employed by substituting nitric for sulphuric acid. (d) The black lead is heated with concentrated nitric or sulphuric acid, scooped out, washed and calcined. To obtain a finer product, the black lead obtained at the end of these processes can, if desired, be thrown into water, stirred, scooped off, and dried.

SELECTED FORMULÆ.

Disinfectant.—A good disinfectant, recommended by the Illinois Board of Health, is:

Iron sulphate	13 ounces.
Crude carbolic acid	12 "
Water	48 "

—Pharmaceutical Era.

Headache Tablets.—

Powdered acetanilid	300 grains.
Caffeine	50 "
Sodium salicylate	400 "
Sugar	50 "
Powdered acacia	25 "

Mix intimately, then moisten, and pass through sieve and dry. Lubricate with vaselin, and, when dry, pass through sieve again. Finally, make into compressed tablets.—Spatula.

Depilatory Collodion.—

Iodine	75 centigrammes.
Oil of turpentine	20 drops.
Castor oil	2 grammes.
Alcohol	10 "
Collodion	30 "

To be applied once daily for three or four days. When the collodion is removed, the surface beneath is rendered free from hair.—Bull. de Pharm. de Lyons.

Acid Phosphate Solution.—

Phosphoric acid	64 parts.
Precipitated chalk	12 "
Calcined magnesia	1 "
Potassium carbonate	1 "
Distilled water	178 "

Add the chalk to the acid gradually, and then add the magnesia and stir well. Dissolve the potassium in 9 oz. of the water, add the solution gradually to the acid liquor, admix the remainder of the water, set aside for one or two hours, then filter.

Indelible Inks for Metal and Glass.—Schoebel, in the Fortschritte der Medicin, recommends the following inks for labeling glassware, metal, etc.:

BLACK.

Sodium silicate	1 to 2 parts.
Liquid India ink	1 part.

WHITE.

Sodium silicate	3 to 4 parts.
Chinese white (Winsor & Newton's)	1 part.

Barium sulphate may be used instead of the Chinese white, in the same proportion.

The bottles containing these inks should be kept air tight, and, of course, should be thoroughly shaken before using. Steel pens may be used for writing with these preparations.—National Druggist.

Ammoniated Collodion.—

For bites and stings of insects.

Ammonia water	5 drachms.
Collodion	6 "
Salicylic acid	3 grains.

Mix and apply.—Pacific Med. Jour.

Tolu Chewing Gum.—Take 3½ pounds gum chicle, 1 pound paraffine, 2 ounces balsam tolu, 1 ounce balsam of Peru; dissolve the gum in as much water as it will take up; melt the paraffine and mix all together, then dissolve 10 pounds of granulated sugar and 4 pounds of glucose in 3 pints of water; boil to "crack" degree and pour the sirup on an oiled slab and work into it sufficient of the gum mixture to make it tough and plastic. It may be flavored with cinnamon, chocolate, myrrh, ginger, sandal wood, etc. When cool, roll into sticks.

To Take Oil Stains Out of Linen.—Immerse the goods in a soap bath, which should be kept at nearly the boiling temperature. If the stains are fresh, smear them with tallow or lard, and afterward rub the goods with soap in cold water. Benzine or turpentine is also sometimes successfully used in removing oil stains. How to remove stains caused by acids, vinegar, etc.—For white cottons and linens: Wash with pure water or warm chlorine water. Colored goods or silks: Ammonia diluted according to the fineness of the tissue and delicacy of the color. Coffee and milk stains may be removed from silk, woolen or other fabrics by painting over with glycerine and then washing with a linen rag dipped in lukewarm rain water. It is afterward pressed on the wrong side with a moderately warm iron as long as it seems damp. The most delicate colors are unaffected by this treatment. For removing grease spots from white linen or cotton goods, use soap or weak lyes; for colored calicoes, warm soapsuds; for woolens, soapsuds or ammonia; for silks, benzine, ether, magnesia, chalk, yolk of egg with water.—Pharmaceutical Era.

Listerine.—W. N. Sherman (Pac. Drug.) says the following makes a preparation not easily told from the original.

Acid benzoic	2	drachms.
Borax	2	"
Boric acid	4	"
Thymol	¾	"
Eucalyptol	10	drops.
Oil wintergreen	10	"
Oil peppermint	6	"
Oil thyme	2	"
Rectified spirits	5¾	oz.
Water, enough to make	31	fl. oz.

This still lacks baptisia. It is claimed by the makers that this is one of the ingredients used.

Cement for Attaching Leather to Iron Pulleys.—Cut your leather roughly to shape, allowing about 1 inch per 12 inches in the width of the pulley. Then soak your leather in water until it is wet through. Now stretch it well in the direction of the circumference of the pulley, and cut it to exact shape and length. It should next be sewn up, butt to butt, with a shoemaker's awl and thread, and the leather, having been stretched in the direction of circumference only, will, as it gets dry, have a tendency to resume its former shape, thereby shortening in circumference and "clip" to the pulley. A shallow groove might be made for the stitches to sink down in.

ENGINEERING NOTES.

A train now runs between Paris and St. Petersburg in forty-eight hours, the only change of cars being on the Russian frontier.

A new line of railway is now being surveyed from Borgo-San Domingo to Cremona, Italy. It will cross the province of Plaisance, and will ultimately effect a junction with the Plaisance-Milan line.

The shipping trade of Montreal seems to be on the increase, and the harbor authorities have extended the wharfage and deepened the ship channel by the removal of shoals. When the works are completed the harbor will have a depth of 27 feet 6 inches. Last year 640 seagoing vessels, with an aggregate tonnage of 1,069,386, called at the port during the seven months in which navigation was open.

London has been aroused to the necessity of having a thirty foot channel open into the Thames at all stages of the tide, in order to be able to compete with Southampton and Liverpool. The Leigh middle shoal acts as a bar to the river; through the channel in this no vessel drawing twenty-eight feet can pass at low water. Vessels drawing twenty-seven feet can pass only thirteen days in the year, and those drawing twenty-five on 125 days.

Liquid fuel has been definitely adopted for the two German coast defense vessels, Odin and Ægir, after a series of experiments made on torpedo boats as well as on the Siegfried. The fuel consists of hydrocarbons of great heating power, its principal element being products distilled from Russian petroleum, mixed with other oils. The evaporation is eight or nine times as powerful as with coal. Besides which, the specific gravity of this fuel being much less than that of coal, a much larger quantity can be carried, and hence the radius of action of the vessel is greatly increased.—Le Yacht.

The Deutsche Heeres-Zeitung reports successful experiments in crossing rivers with waterproof tent equipments. These are spread upon the ground and covered with a bed of straw, hay, leaves, or other like matter, upon which clothing and articles of equipment are placed, and the whole is then rolled up in the form of a bundle or bale. The packages thus formed float because of the quantity of air they confine. The rifles are fixed upon the top and the bundles are dragged across by swimmers employing tent ropes. For men who are unable to swim, bundles are filled entirely with straw, and these, being fixed together and made rigid by tent poles crossed on the top, form rafts which can either be hauled across or be navigated by means of spades used as paddles.

A very simple method of preventing hard deposits in steam boilers is mentioned by M. Schmidt, a French engineer. There are two boilers in use. Each boiler is allowed to go on working for about 500 hours before being cleaned, when it is stopped, with the water in it, and allowed to cool down for about a week; the masonry is allowed to become cold, and then the tap is opened, also the safety valve, so that the water runs naturally out of the boiler, the latter, when empty, being entered and simply swept. The deposit, being in the form of damp mud, is easily swept away, leaving the boiler as clean inside as if it were new. This method has been in use some five years, and seems to show that the ordinary hardening of deposits in boilers is due to the absence of water in them while the mud and the iron are being heated by the brickwork when the boiler has been emptied by the ordinary method under pressure. It is necessary, however, under this system, to be able to do without the particular boiler for some eight days.

Another steel hardening process is announced as having been introduced at the famous French steel and iron works of Creusot—a process based upon the fact, well known, that gas, under great heat, deposits carbon in solid form, upon this depending its light effects and also the formation of the so-called retort graphites, a thick covering of pure carbon on the walls of gaslight retorts, the gas that strikes the walls depositing part of its carbon upon them. Hardening iron and steel plates formerly consisted in covering the plates with layers of coal and heating them till they glowed; in the new process, two plates are put into a furnace, one on top of the other, with a hollow space between, this space made gastight by means of asbestos packing put on around the edges, and the plates heated red hot, while a stream of gas is poured into the hollow space indicated. The carbon thrown out by the gas is readily taken up by the glowing plates until they are quickly covered, and the depth of this carbon covering can be regulated by the amount of gas admitted. In order to secure regular and uniform action during the process and to prevent the pipes that carry the gas to the hollow space from absorbing any of the carbon, they are insulated in other pipes, through which water is constantly circulating.

M. Goubet, French inventor of submarine boats, recently constructed a boat of that kind for a South American republic, says the Marine Review. The vessel in question is 27 feet long by 5·8 feet in diameter. Its hull consists of three gun metal castings, viz., conical stem and stern pieces and a middle ring. The shell is 1 inch thick in the middle and ⅜ inch at the ends. Access to the interior is gained through an oval manhole in the central belt. The torpedoes with which the boat is armed are carried outside the shell, and can be released at will, the same action starting their propellers into motion. The propeller of the boat is mounted on a shaft fitted with a universal joint, and steering is effected by suitably moving the propeller. Underneath the hull a weight of 1¼ tons of lead is fitted, which can be released in case of emergency, thus increasing the buoyancy of the vessel very materially. The screw is operated by an electric motor of about two horse power, which will give, it is stated, a speed of seven or eight knots. Oars are also provided, so that when necessary the boat can be maneuvered by hand. These oars are of special construction, in order to fit them for use entirely under water. The crew consists of an officer and two men. An "optic tube" fitted with reflectors extends to the surface, thus enabling the boat to be guided in the desired course.

ELECTRICAL NOTES.

Storage electric traction is to be tried in Chicago on about twenty miles of new line in the southwestern part of the city. Chloride batteries are to be used.

Electric motocycles are proposed for the park at Lake Harriet, Minneapolis. The idea is to run large carriages, capable of carrying twelve persons each. A floating race track for bicycles, lighted with electricity, is also proposed.

The telephone and the telegraph are rapidly making inroads into the arid portions of the Desert of Sahara. Engineer Bayolle is now on the way from Biskra to Tuggurth with a working force of 100 men, for the purpose of laying telegraph wires between the two places.

An electric ice cutting machine recently tried on a lake up in New Hampshire consisted essentially of a sled, propelled by an electric motor and wheels like a mowing machine, and carrying several circular saws that eat into the ice. Current was brought from shore through a flexible wire that drags along over the ice.

The researches of M. Moissan and others with the electric furnace have shown that under the influence of the electric arc zirconium forms a carbide of the formula ZrC_2. It now appears that at lower temperatures another carbide of the formula ZrC is produced. This does not decompose water, but is attacked by acids and by oxidizers, in the latter case very vigorously.

The pumps at the city water works of Fresno City were run by electricity for the first time on April 14, 1896. The new company, which is bringing the power from the San Joaquin River, thirty-five miles distant, has turned on the current. A test was previously made with lights, and since that time additional machinery has been put in, and a seventy-five horse power pump was run with great smoothness.

Statistics of electric lighting in Japan to the end of 1895, not including any isolated plants, are as follows, says the Electrical Friend: There are 31 electric lighting companies, eight of which use water power and the others steam; the total number of incandescent lamps is 90,150, or, reduced to their equivalent in 8 candle power lamps, 138,327; the number of arc lamps, nearly all of which are of 1,200 candle power, is 420.

After a long series of careful observations one of the principal electrical companies in the United States has decided to put Crookes tubes on the market, and tubes of approved sizes and types may now be purchased. "It is said," says the Electrical Review, "that very successful results have been obtained with the tubes already furnished. Experiments are being continued in order that the most improved forms may be within reach of the public continually."

In making tests of rods by the magnetometer method, it is usual to assume that as far as the self-demagnetizing forces are concerned, the cylinder is equivalent to a very long ellipsoid. That this assumption, the Electrical Review says, is not quite true is well known, and the question has been gone into by several observers. The latest research on the question is by Mr. C. R. Mann. He finds that up to a certain value of the intensity of magnetization, at about the point where the linear relation between I and H ceases in the reversal curve, the cylinder is very nearly represented by an ellipsoid, but after that the ellipsoid takes up a much greater magnetization for the same magnetizing force than does the cylinder. For a length ratio of 20 to 30, the deviation from the corresponding ellipsoids is a maximum.

A curious experiment with the phonograph was recently described in Power. The machinery of a large pumping works in California, erected by a New York firm, had got out of order, and to avoid the great expense of sending an expert to the Pacific coast to put the machinery into working order, the manager determined to utilize the phonograph. He brought the receiver to the machinery so that the peculiar sounds of the pulsations of the defective pump was recorded on the wax cylinder. The wax cylinder was sent to New York with a full description of the symptoms which had been observed by the manager. The experts were enabled to tell what was the matter with the pump from hearing the sounds made by the phonograph. The proper remedy was suggested and the pump was repaired, and is now running satisfactorily.

Retort carbon is proposed as a material for the manufacture of resistances on the principle covered by a patent in Austria of Sirius Fabrik. A meter length of carbon of one square millimeter cross section would give a resistance of about 75 ohms at 0° C., with a temperature coefficient of 0·00052, its specific resistance being nearly 80 times greater than that of manganese copper. An adjustable resistance for arc lamps consists essentially of a quantity of the best round lamp carbons of the customary length arranged between two slate plates in such a manner as to permit of expansion and with the necessary connections. The whole is covered with a perforated metal screen. The Electrical Engineer considers that there should be a place for apparatus of this class in alternating current work, since, owing to the short length required and the avoidance of the coil form, self-induction is obviated.

The Centrale Zurichbergbahn is a line about a mile and a half in length with severe gradients, and with curves of as little as 18 yards radius. It is worked on the overhead electric system, but the most noteworthy thing about it is that, instead of a steam plant, the power supply at the generating station is derived from Crossley engines and Dowson gas, says the English Electrical Engineer. The plant is in duplicate—that is, two sets of producers and engines. The latter are about 50 horse power, and are belted to the dynamos. These are four-pole compound-wound Oerlikon machines, and are worked in connection with an accumulator, a supplementary dynamo being provided for charging this. The voltage is 550. The plant has been working about nine months, but no figures are at present available to show whether a superior economy has actually been realized over what could have been obtained by the use of steam engines. It is, however, understood that the management consider the working and results to be satisfactory.

MISCELLANEOUS NOTES.

In Germany asparagus is peeled before being canned, by the aid of a special machine.

It is said that a certain Swedish copper mine has been worked without interruption for eight hundred years.

Two hundred and forty-five thousand dollars per annum has been offered and refused for the privilege of sorting the garbage of New York City.

One hundred and forty-two thousand three hundred and seven dollars and sixty cents' worth of dimes were coined at the San Francisco mint in 1890; that is 1,423,760 pieces.

It is said that in one office building in New York City there are 402 typewriting machines. The Czarina of Russia has recently ordered a typewriter with gold type bars and the frame inlaid with pearl.

As somewhat of a curiosity, I may mention the invention here of a lamp for burning currant spirit. On the score of cost, however, it would seem that this method of illumination is much dearer than the systems at present in vogue.—Handels Museum; Austro-Hungarian Consul at Piræus-Athens, January, 1896.

Balloon racing is the latest form of petty gambling in Paris. A number of toy balloons are set off at the same time, each bearing a postal card having on it the umpire's address and a request to the finder to note the time and place of the balloon's arrival. Bets are paid and the stakes awarded on the results of the replies received within a week. The balloon that goes furthest in the shortest time gets the prize.

A general abstract of the marriages, births and deaths registered in England in 1895 states that the number of persons married was 455,730, of births 921,860, and of deaths 568,758. The births comprised 468,753 males and 453,107 females and the deaths 290,714 males and 278,044 females. The persons married amounted to an average of 15 per 1,000 of the estimated population in the middle of the year; the births to 30·3 per 1,000; and the deaths to 18·7 per 1,000.

There is no part of the world which has such a black record for wrecks as the narrow Baltic seas, says the Marine Review. The number in some years has averaged more than one a day, the greatest number of wrecks recorded in one year being 425 and the smallest 154. About 50 per cent. of these vessels became total wrecks, all the crews being lost. In the four years 1877-81 no less than 700 lives were lost. It must be noted with regard to these wrecks, however, that many of the vessels navigating these seas are old and ill found, especially those engaged in the timber trade.

India rubber has been generally considered absolutely watertight, but experiments with a hermetically sealed rubber bottle of water show that it is not. The original weight of the bottle filled with water was 1 pound 1 ounce 4 drachms; in one year 1 pound 1 ounce and 2 drachms; in 9 years, 1 pound; in 18 years, 14 ounces 2 drachms; in 23 years, 13 ounces 4 drachms; in 25 years, 7 ounces 8 drachms; in 28 years, 3 ounces 14 drachms; in 30 years it was cut open and found to be quite dry. The bottle then weighed 3 ounces and 12 drachms.

Neither Andorra nor San Marino can claim to be the smallest independent territory in Europe, says the Westminster Gazette. That position belongs to Tavoralo, an islet off the northwest coast of Sardinia. Its size is three miles long and three-quarters of a mile broad, and its population numbers exactly fifty-five souls. From 1836 to 1882 the islet was governed by one Paoloto, who had all the authority of a king, but when he died, in the latter year, he advised the inhabitants to form a republic, which was done. All the adult islanders, women equally with men, have votes, and every six years a president is elected for that period.

A clerk in the redemption division of the Treasury Department says that the "cleanest" paper money in circulation is that which circulates in Washington, while the dirtiest is that which comes from Chicago for redemption, says the Washington Star. St. Louis is a close second to Chicago, and Cincinnati next. New York is next to Washington in the record for clean money, Philadelphia next, while Baltimore ranks next to Cincinnati for having dirty money. The money that comes in from Chicago, besides being dirty, is always much mutilated; so much so, he said, that there is twice as much time consumed in patching it up prior to cancelation as there is in counting it.

The New York Engineering News says: "A universal census is proposed for the year 1900, and the proposition was discussed at the meeting of the International Statistical Institute at Berne. A committee is to be appointed by the institute, which is to advise as to the most convenient date for the census and to determine and formulate important questions of general interest, leaving each country to supplement these as it deems fit. The terms to be used in the census papers should also be accurately defined, so as to avoid ambiguity and to obtain identical results; and, most important of all, the committee is to offer suggestions as to the best means of obtaining united action in several countries. This committee is to report at the next meeting of the institute in 1897."

M. W. De Fonvielle, the well known aeronaut, has been collecting reminiscences of the balloon voyagers who left Paris during the siege in 1870, says Leisure Hour. Gambetta was accompanied by M. Spuller, one of the survivors of the 169 persons who left Paris in that year by aerial transit. The number of balloons that made the voyage was 166, carrying 169 passengers, 3,000,000 letters, 363 carrier pigeons, and 5 dogs, which were expected to be sent back with messages and letters. Of the 166 balloons, 52 fell in France, 5 in Belgium, 4 in Holland, 2 in Germany, 1 in Norway, and 2 at sea. Five of the 52 which fell in France were captured by the Germans. It is a most interesting addition to the historical recollections of the famous siege. The scenes on the arrival of the pigeon-borne letters, when crowds assembled to see the news when magnified by lenses on the screens, are familiar to the readers of records of the siege.

THE AUSTRO-HUNGARIAN FLEET ON THE DANUBE.

ALTHOUGH it is not generally known, there is a little fleet on the Danube that belongs to the Austro-Hungarian navy. It now consists of four monitors, a torpedo boat and a patrol boat, but it is to be reinforced by some larger monitors and a number of torpedo boats, as much more importance is attached to this fleet since the destruction, by blasting, of the rocks known as the Eisernen Thor. On account of the increased number of boats a little harbor will have to be provided for the fleet at Budapest. The four monitors referred to above—one of which is shown in the accompanying engraving—were built at the shipyard of Messrs. Schonichen & Hartmann, at Budapest. They are of the same type, and each one is 177 ft. long, 29 ft. broad, and has a draught of 4 ft. and a displacement of 448 tons. The engines indicate 1,350 horse power, and the speed of the vessels is 10·5 miles an hour. They are each provided with a girdle of armor 2·9 in. thick, and on deck there are two revolving turrets, each containing a 12 cm. rapid firing gun, the armament being completed by two 7 cm. rapid firing guns and two 8 cm. Maxim guns. The crew of each monitor consists of 75 men. The total displacement of the present Danube fleet is 1,556 tons, and it carries 23 guns and about 300 men; but these figures will soon be doubled.—Illustrirte Zeitung.

THE ORIGIN OF THE BESSEMER PROCESS.

To the Editor of Engineering:

Sir: It will be within the recollection of your readers that in my reply to the statement made by Mr. J. D. Weeks to the American Institute of Mining Engineers (in which he claims for a Mr. William Kelly the originality of the Bessemer process) I pointed out the fact that one of his witnesses, Mr. John E. Fry, gave us very minute details of the preliminary stages of Kelly's process, even to describing the kind of trolley on which the ladle of metal was conveyed to the apparatus, and how the metal was "dumped" into the open furnace, across the top of which pieces of sheet iron were laid to prevent the sparks flying too freely. I then went on to say, "And here the evidence drops short, for it is clearly not worth their while to pursue the subject any further; it would be dangerous to do so; it would, in fact, 'let the cat out of the bag.' These discreet witnesses have given all the very interesting details as to the 'dumping' in of the molten iron, even to the kind of 'little hauling car' which conveyed the metal to the apparatus; but it would have been infinitely more to the purpose if they had told us something about the way in which this metal was taken out, in what state of partial or complete solidity was it obtained, and whether it was soft malleable iron or hard and brittle 'plate metal.' They have told us nothing of the use of ingot moulds, in which the malleable iron must be made into ingot; they have told us nothing of the treatment of the metal after it was blown. Was it taken to the puddling furnace, to be there converted into wrought iron, or was it rolled into bars or sheets from ingots formed while in a fluid state? Without all these essential facts, all their testimony and affidavits are worse than waste paper, as they directly prove nothing; but the absence of these facts affords very strong circumstantial evidence that Kelly never had produced homogeneous malleable iron, and had never made an ingot by his process."

Now it appears that Mr. Fry was not guilty of this suppression of facts, for in a two hours' conversation with Mr. Weeks, Mr. Fry states that he gave him vivid personal recollections, antagonistic to his views, and the drawing he supplied proved that as late as the year 1858 (two years after Bessemer's patent) "Mr. Kelly's experiments and ideas had not progressed beyond the operations of the finery fire."

The letter accompanying these remarks shows that Mr. Fry was not guilty of this suppression of important facts, which went to show that up to 1858 (two years after my patent) Kelly's experiments had not progressed beyond the operations of the "finery fire." Mr. Fry also gave Mr. Weeks an article published in the year 1894 in the Johnstown Daily Democrat, written by Mr. Fry, and which he says "gave what I believe to be the very first public announcement of Mr. Kelly's absolute failure to accomplish anything that could give ground to his claim of being the inventor of the pneumatic process of converting cast iron into its malleable products."

It is then not Mr. Fry who was guilty of this wholesale suppression of the truth, of which he says Mr. Weeks had full knowledge, and which he had derived from sources chosen by himself.

The honorable and disinterested love of truth and fair play which has prompted Mr. Fry to send me the following account of his long interview with Mr. Weeks shows how worthily Mr. Fry has risen from the ranks to the honorable position of manager of the great Cambria Steel Works. Yours truly,

Denmark Hill, May 5, 1896. HENRY BESSEMER.

"5417 Penn Avenue, Pittsburg, Pa., U. S. A.,
"April 20, 1896.

"Sir Henry Bessemer, London, England:

"Esteemed Sir: Your letter to the technical press of England, in reply to Joseph D. Weeks' address to the American Institute of Mining Engineers in session at this city in February last, has been read by me as published in the London Engineering of the 20th ult. I have no desire to take part in the controversy which naturally follows a resurrection of this long buried question of priority of invention of the Bessemer process, but only share the desire of all fair minded persons that facts, rather than personal prejudices and interests, may be made matters of history.

"In your letter referred to above you requote a quotation by Mr. Weeks which he credits to an interview he had with me a few days prior to the delivery of his address to the Institute. Your reference to the quotation indicates that it ended abruptly, because I, 'one of Mr. Weeks' witnesses,' had something to suppress as to the outcome of the experiment which would not be favorable to the views of Mr. Weeks as to the late William Kelly's claims to the invention in discussion. It is to advise you that the 'suppression' was by Mr. Weeks, and not by me, that I now recite to you the facts of the interview referred to, and others germane to the discussion.

"While Mr. Weeks was preparing his address he sought data by application to Mr. John Fritz, who was general superintendent of the Cambria Works, at Johnstown, Pa., at the time Mr. Kelly went there to conduct his experiments. Mr. Fritz had no recollection of the events relative thereto beyond having detailed me to assist Mr. Kelly in every way by assembling such materials as he required, and to collaborate with him in his experimental work. Mr. Fritz, therefore, referred Mr. Weeks to me for data of Mr. Kelly's experiments. At Mr. Weeks' request I called at his publication office in this city, and the interview lasted two hours. During this time I gave him my quite clear recollection of what Mr. Kelly tried to do, what he did, and what he failed to accomplish which he hoped to do. Also I gave him a drawing, made by one of our shop hands at the time, of Mr. Kelly's apparatus of the year 1858, which drawing Mr. Weeks designs having engraved for future publication, if it can be made to fit his side of the discussion, which I believe it will not. Moreover, I gave him a copy of a publication issued in Johnstown, Pa., in the autumn of 1894, in which was printed an article written at that time by me under caption of 'The Bessemer Industry: Johnstown's Contribution to it.'

"My interview with Mr. Weeks gave him vivid personal recollections antagonistic to his views. The drawing proved that as late as the year 1858 Mr. Kelly's experiments and ideas had not progressed beyond the operations of the 'finery fire,' and the printed article gave what I believe to be the very first public announcement of Mr. Kelly's absolute failure to accomplish anything that would give ground to his claim of being the inventor of the pneumatic process of converting cast iron into its malleable products, or in substantiation of the rather vague claim allowed him in his first patent, issued subsequent to the issue of yours in this country.

"Now, with this presumably trustworthy testimony at his disposal, Mr. Weeks suppressed all except the insignificant extract he quoted relative to Kelly's first apparatus at the Cambria Works, and which you very properly characterized as incomplete reference to the first Kelly experiments there.

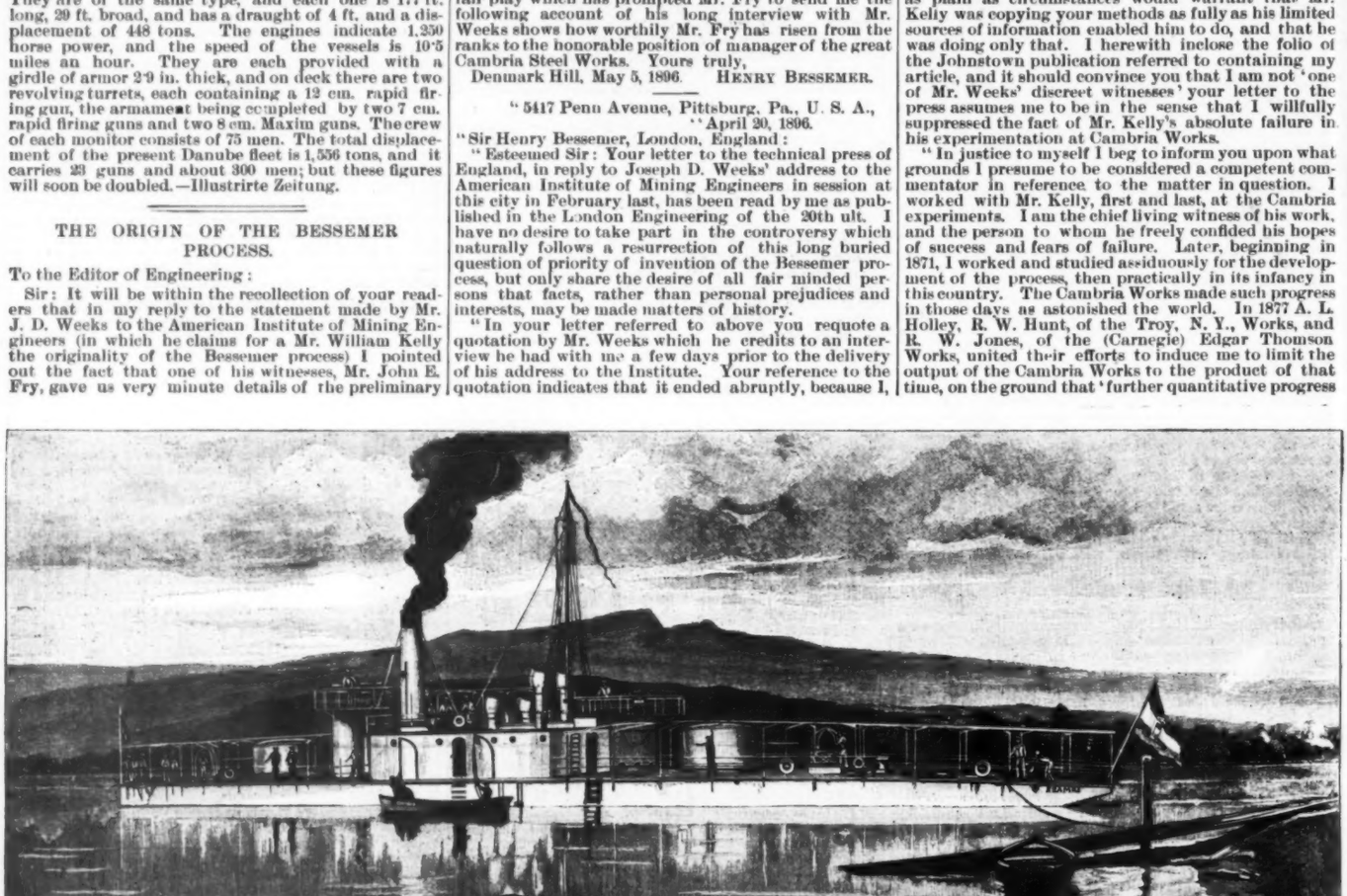
"On October 24, 1894, I mailed to you a copy of the Johnstown publication above referred to containing my article, which must have miscarried in the post, or you would have known that my views were diametrically opposed to those of Mr. Weeks, for in it I made as plain as circumstances would warrant that Mr. Kelly was copying your methods as fully as his limited sources of information enabled him to do, and that he was doing only that. I herewith inclose the folio of the Johnstown publication referred to containing my article, and it should convince you that I am not 'one of Mr. Weeks' discreet witnesses' your letter to the press assumes me to be in the sense that I willfully suppressed the fact of Mr. Kelly's absolute failure in his experimentation at Cambria Works.

"In justice to myself I beg to inform you upon what grounds I presume to be considered a competent commentator in reference to the matter in question. I worked with Mr. Kelly, first and last, at the Cambria experiments. I am the chief living witness of his work, and the person to whom he freely confided his hopes of success and fears of failure. Later, beginning in 1871, I worked and studied assiduously for the development of the process, then practically in its infancy in this country. The Cambria Works made such progress in those days as astonished the world. In 1877 A. L. Holley, R. W. Hunt, of the Troy, N. Y., Works, and R. W. Jones, of the (Carnegie) Edgar Thomson Works, united their efforts to induce me to limit the output of the Cambria Works to the product of that time, on the ground that 'further quantitative progress would congest the market for steel and ruin the business.' Needless to say the proposition was declined, nor that they all experienced a change of view of the market later on. I was manager of the Cambria Steel Works at this time and during the years prior to 1882, when they were producing more Bessemer steel than any plant of similar converter capacity in the world. I have been a leading exponent of the process here in its encroachment upon the field of the open hearth in the manufacture of special steels, and especially in sustaining it against the assertion of many notable authorities that 'its irregularity of physical behavior unfitted it for structural work.' The steel in the superstructure of the Brooklyn Bridge (East River, N. Y.), made at Cambria, was a sufficient answer to such. I have been in close touch with the process up to today in its most advanced development, and these experiences, with a keen recollection of events, should qualify me as a fairly trustworthy witness. All my friends know me as such, and as a frank one.

"Mr. Weeks took advantage of me in his misuse of the short quotation referred to. This was misleading to you, as to others, hence your intimation of my holding opinions prejudicial to the facts and consistent with Mr. Weeks' argument adulatory of Mr. Kelly. Naturally I feel that your reference to me as a biased witness is an unmerited reproach. If almost a lifetime of service to employers faithfully performed does not entitle me to a reputation for honesty and integrity of expression, then I have lived and labored in vain.

"Respectful consideration for the memory of those who have passed away demands as considerate reference to their achievements as words at command will give expression. It is beautiful and dutiful to only speak kindly of the dead. In the accompanying article I have kept these considerations in view.

"The question as to whom the credit of the invention of the pneumatic process is due has in my opinion, as in yours, been settled in your favor beyond controversy. It seems ghoulish work to resurrect it now, after its forty years of sepulture, in any effort to ad-



THE AUSTRO-HUNGARIAN FLEET ON THE DANUBE—AN AUSTRIAN MONITOR, THE SZAMOS.

vance undeserving interest. In my humble opinion, Mr. Weeks, as the president of the American Institute of Mining Engineers, made an impolitic choice of subject for his address, especially considering the material at his command, represented in this city by manufacturing establishments in sight and hearing of his distinguished audience.

"I know that it is one of the careless ways of a selfish world that credit is not only not given where due, but is too frequently withheld and misconferred. A consciousness of duty well done to our fellow men must be the compensation in such instances. But only pure selfishness prompts the theft of others' achievement. Needless to add that pure selfishness is not a rarity, and few live to maturity who do not experience its adverse influences. Respectfully yours,

JOHN E. FRY."

MIXED CONSTRUCTIONS WITH METALLIC SKELETONS.

MIXED constructions with a steel skeleton surrounded with cement have, during the past few years, given rise to applications of great importance, especially in the installation of pipe lines of wide diameter and under pressure, and in the establishing of bridges, reservoirs, flooring of wide span, etc. We find them in particular in the great works recently executed for the city of Paris in view of the creation of new fields of sewage distribution. They have served, for example, to constitute the delivery pipe of Argenteuil, whose diameter, as well known, reaches 6 feet for a length of 4,920 feet, and also in the entire distributing system of the plain of Acheres, composed of pipes of a total length of 8¾ miles with diameters varying from 16 inches to 3½ feet.

We have here a very curious type of work, and we have thought it of interest a give a few details on the subject, borrowed from data published in the Genie Sanitaire.

Mr. Bonna, the inventor of this type of construction, proposing to obtain pipes or other work possessing the necessary resistance to support strong pressures, while at the same time preserving elasticity to resist exceptional supercharges without breaking, employs to this effect a metallic skeleton formed of steel rings to which he even adds solid iron plates, if need be, and incloses the whole in cement.

The arrangements adopted are so studied as to utilize in the most rational manner the respective qualities of the two types of materials employed—the steel working by tension, while the cement works by compression.

The dimensions of the work to be executed are there-

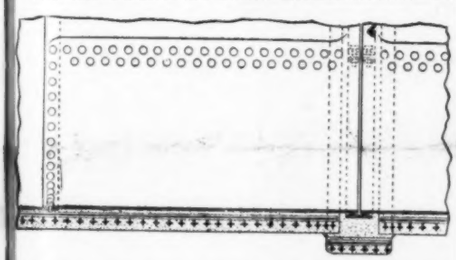


FIG. 1.—Longitudinal Section, Showing the Arrangement of the Mixed Pipes with Internal Iron Plate and also the Joints.

fore calculated in starting from this fundamental distinction, by assigning to each of the elements to be brought into play such formulas of resistance as pertain thereto.

It is easy to see that a piece of work thus constructed possesses great resistance, since, as remarked by Mr. Considere, iron surrounded with cement is capable of working up to its limit of elasticity before the concrete begins to crack, and is therefore situated under excellent conditions, and protected against distortion, while its duration may equal that of the cement itself.

We know, moreover, that cement, in time, acquires a considerable increase in resistance, and this dispels all inquietude from that point of view.

As an example of the great resistance that such work is capable of exhibiting, the Genie Sanitaire cites an experiment made in 1893 by Mr. Launay, engineer in chief of the work of purifying the Seine, and which it is of interest to mention here.

A pipe 20 inches in diameter, consisting of steel plate internally and covered with an armor of steel spirals, and this surrounded with a coat of concrete 1½ inch thick, had been calculated to resist a pressure of 65 feet of water in adopting 11,000 pounds to the square inch as the coefficient of maximum tension. Upon trial, it was found capable of supporting a pressure six times greater (reaching 387 feet, corresponding, for the steel, to a tension of 16,250 pounds) before any leakage occurred.

Mr. Bonna observes, besides, that these mixed conduits are capable of undergoing a prolonged service without the occurrence of any deterioration resulting from the heterogeneousness of the elements employed.

As regards the variations in temperature, for example, the experiments made at the School of Roadways and Bridges by Messrs. Durand Claye and Debray have demonstrated that they have no prejudicial action, since the coefficient of expansion of iron and steel, comprised between 0·0000130 and 0·0000148, presents a value sensibly equal to that of cements, 0·0000135.

On another hand care was taken to measure the adhesive force of cement with iron, and it was found that it was capable of reaching from 570 to 670 pounds to the square inch, almost equal, consequently, to the resistance peculiar to cement; so that no effect of disintegration due to a want of adhesion is to be feared.

Finally, let us add that the experiments made by Mr. Considere with pieces of iron embedded for several years in masonry in the sea showed that the iron was preserved exempt from rust and perfectly adherent to the cement. This dispels all fear of oxidation likewise.

At first immediately after they have been laid, cement conduits are not perfectly tight. For some time, there is observed a transudation at the exterior resulting from the porosity of the concrete after moulding. The water under pressure then tends to pass through the sides of the conduit; but it soon closes the pores of the concrete through the lime that it carries along, which becomes carbonated. When the pressure of the water exceeds 50 feet, it is well, however, to have recourse to special arrangements to secure tightness. Thus in the great Argenteuil conduit and in the Achères pipe line, the pressure in which reaches 130 feet, Mr. Bonna adopted a coupling admitting of the application of a riveted steel plate tube placed in the interior or in the median part of the pipe outside of the carcass of steel rings, which always remains embedded in the cement. This is the type represented in Fig. 1.

Figs. 2 to 6 represent the various stages in the manufacture of mixed pipes thus constructed. In Fig. 2 we see the installation of the armature formed of a series of iron rings of cruciform section constituting the skeleton of the pipe. The irons of cruciform section have a width of arm of from ½ inch to ¾ inch and a total height varying from ½ inch to 1½ inch, according to the diameter of the pipe and the amount of the pressure to be supported.

For pipes of small diameter, these irons are simply rolled in a continuous spiral. In the large ones they are formed by preference of independent riveted rings. They are always connected with each other by steel bars called generatrices, of the same section as the rings. These generatrices are provided at the upper part with regularly spaced notches for the reception of the base of the rings, according to the arrangement shown in the longitudinal section in Fig. 1.

The skeleton thus obtained is afterward embedded in concrete in order to form the pipe. At Argenteuil the moulding was done vertically. The skeleton was arranged around a core of steel and covered with three external shells of steel plate, leaving a space equal to the thickness of the pipe.

A rolling carriage of metallic framework (Fig. 4) upon which were placed the troughs for the preparation of the concrete, as well as the accessory equip-

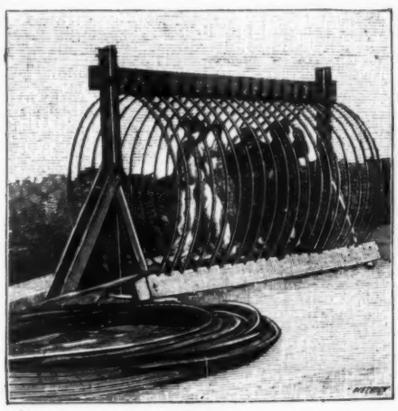


FIG. 2.—Manufacture of the Steel Skeletons of Mixed Pipes.

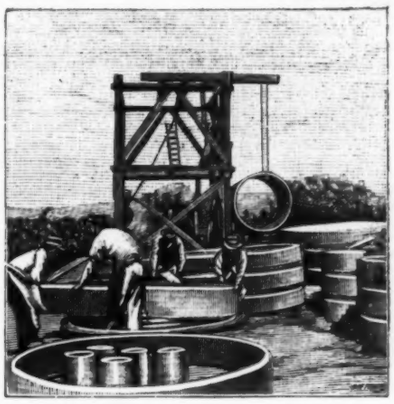


FIG. 3.—Lowering of the Pipes into the Gallery, and the Manufacture of the Joint Rings.

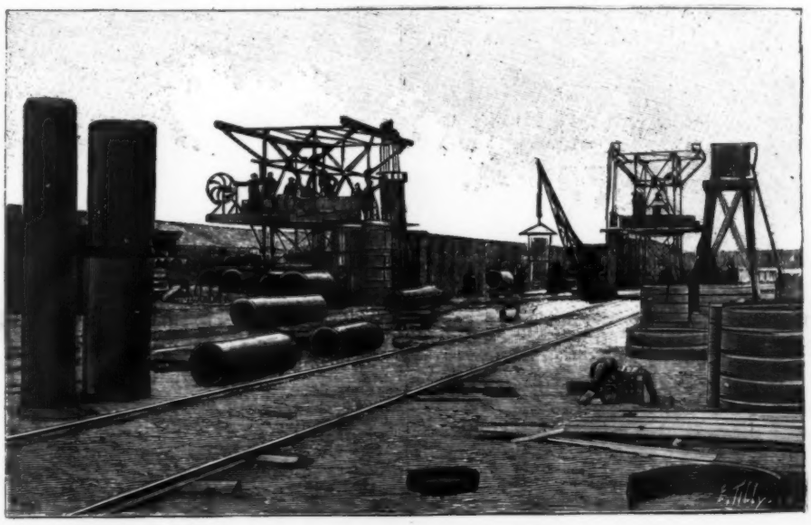


FIG. 4.- General View, Showing the Various Operations in the Moulding of the Pipes.

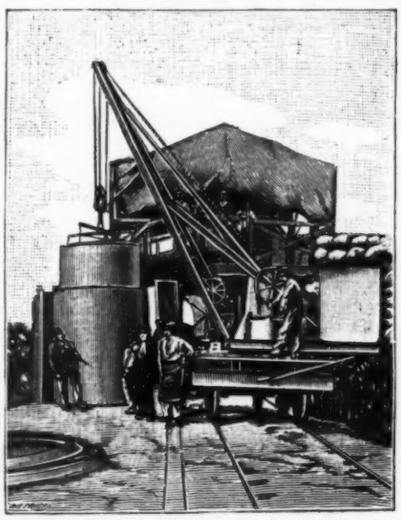


FIG. 5.—Removal of the Core after Moulding.

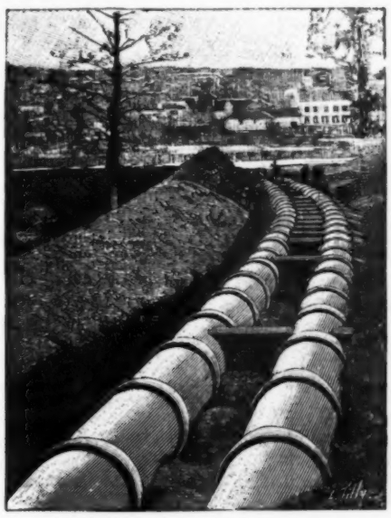


FIG. 6.—Prolongation of the Siphon Passing under the Seine at Herblay.

ments, permitted of moulding pipes 8 and even 10 feet in diameter. Fig. 3 represents the removal of the core, after moulding, by means of a crane that served likewise for putting the moulded pipes upon cars.

The lowering of the pipes into the gallery is shown in Fig. 3 which also gives a view of the place of manufacture of the rings for joints.

The arrangement adopted for the assembling of two successive pipes includes a first internal joint composed of a sheet of rubber-coated asbestos fixed with white lead and covered with a lead ring soldered and driven upon the pipe so as to fit closely to the surface.

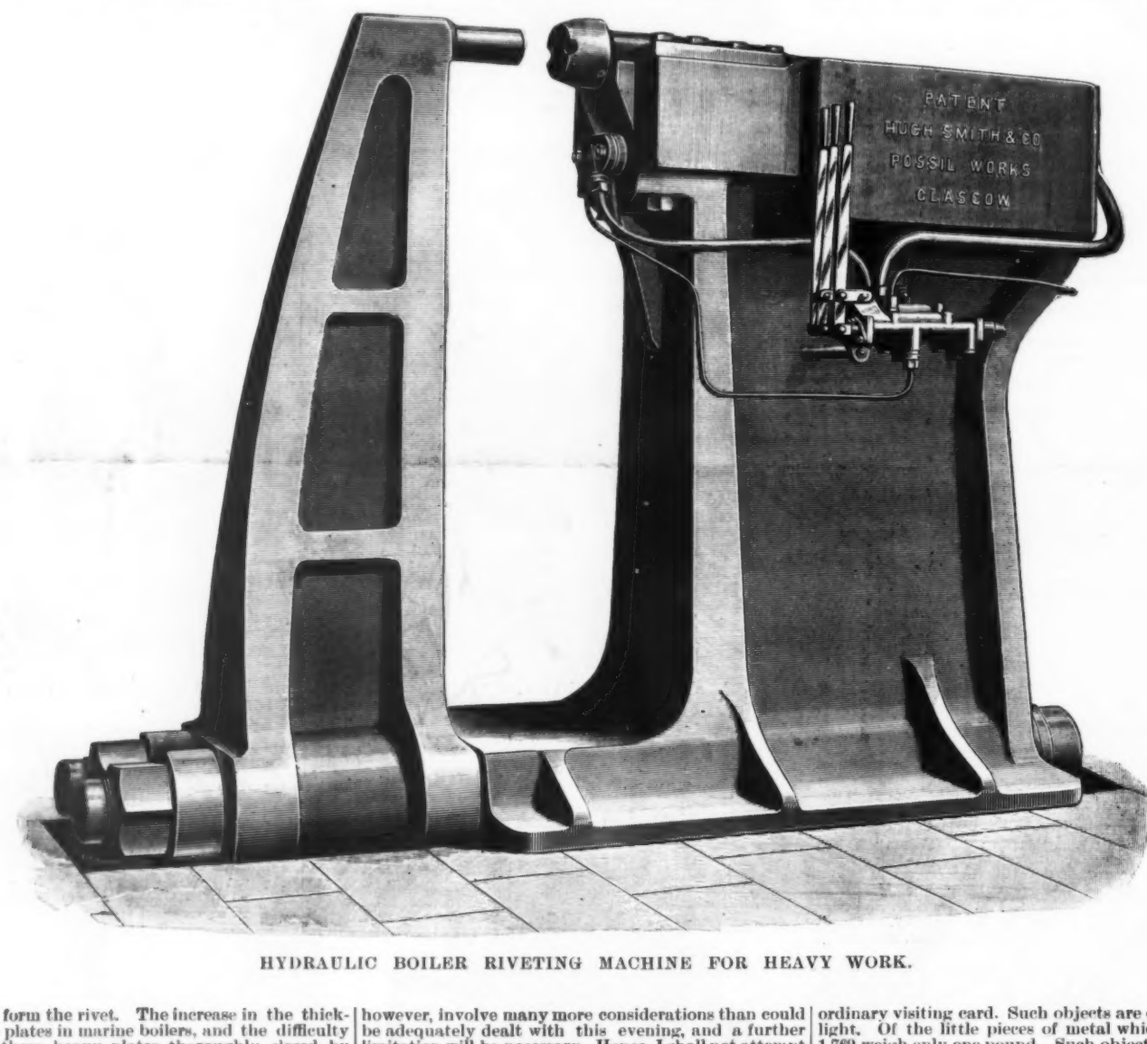
A second joint, designed to assure the tightness of the first, consists of a ring and cement.

Here and there the conduits are provided with compensation joints to permit of expansion. Fig. 6 represents the pipes in place constituting the gallery 3¼ feet in diameter that prolongs the siphons which pass under the Seine at Herblay. One will observe here the conspicuous joint rings of which we have just spoken. —La Nature.

HEAVY HYDRAULIC RIVETING MACHINE.

HYDRAULIC machine tools now play an important part in the work produced from engineering shops and shipbuilding yards.

Our illustration represents Smith's patent hydraulic boiler riveting machine, with plate-closing arrangement. These machines are suitable for every class of work, but have been more especially introduced for riveting heavy marine boilers, and are usually made to put a pressure of 150 tons to close the plates and



HYDRAULIC BOILER RIVETING MACHINE FOR HEAVY WORK.

150 tons to form the rivet. The increase in the thickness of the plates in marine boilers, and the difficulty of getting these heavy plates thoroughly closed by service bolts, has created a necessity for a hydraulic plate-closing arrangement being fitted to the riveting machines. This machine first thoroughly closes the plate with the full power, and then staves and forms the rivet. The machines are made of great strength to stand the pressure, the hobs being made of the best Siemens cast steel, held with two large bolts of best forged steel. They are made of sizes from 6 up to 12 feet gap. We are indebted to the Steamship, of Leith, Scotland, for the cuts and particulars.

MACHINES FOR COMPOSING LETTER-PRESS PRINTING SURFACES.*

By JOHN SOUTHWARD.

THE subject of Machines for Composing Letterpress Printing Surfaces is a wide and a comprehensive one. If time permitted, I should like, in the first place, to refer to the history of inventions of this kind. Such a review would begin with the first patent granted for a composing machine, in 1822, and for a distributing machine, in 1840. It is a remarkable fact that the specifications of these two inventions foreshadow, as it were, the principles of all the composing machines that have since been constructed. As far back as 1842 a popular periodical was actually set up by machine. Up to the year 1860, about thirty machines and modifications of machines were patented. Many machines were made according to these specifications, and were tested in printing offices. They embodied every important principle to be found in the machines that have succeeded them. I fix the date 1860 because I do not find that after that any really new ideas have been enunciated. Indeed, inventors have ever since brought out machines which have been little more than variations or developments of the designs of their predecessors.

I should like, in the second place, to deal with some of the mechanical principles of composing machines. Hundreds of patents have been taken out during the last seventy years, but they may all be divided into well defined groups. There are first of all those in which ordinary types are used. Inventors have devised expedients for increasing the speed of hand composition from the usual cases of the hand compositor. They have suggested specially contrived cases. Others have brought forward inventions for dispensing with cases and providing machines which do nearly the whole of the mechanical part of the compositors' work. Others have gone much further than this, with proposals to do away altogether with movable types, and to produce plates directly, by casting either from punctured or stamped matrices, or from movable and interchangeable metal matrices.

Briefly, the two systems now adopted may be differentiated as typesetting and matrixsetting machines. As I shall be able to touch only the mere fringe of my subject, I must confine myself to an examination of the general features of these two systems. Even these, however, involve many more considerations than could be adequately dealt with this evening, and a further limitation will be necessary. Hence, I shall not attempt more than an inquiry into the economic results of the two systems, and an answer to the question which of them produces letterpress printing surfaces with the greater cheapness. This may seem a somewhat ignoble narrowing down of such a subject, but it is, in reality, the aspect of it which is of greatest present importance and of greatest general interest.

Accordingly, I intend to avoid entering into mechanical details, except when they appear to be necessary to illustrate the points I propose to submit to you. My very cursory examination will not involve a criticism of the merits or demerits of any particular machine. I shall merely contrast the principles of the two main classes of machines with a view, as I have said, to estimate their respective economic advantages.

As probably every one present is aware, an original letterpress surface, to print alphabetical characters and punctuation marks, one that produces the plain reading matter, or text, of books and newspapers, is formed, according to the ordinary method of typography, by combining together, or composing, one by one by hand, movable interchangeable types.

The compositor has these types assorted into little heaps each contained in one of the compartments of his case. According to the wording of the copy he is engaged upon, he first "sights" the type he requires. He picks it up with his thumb and fingers and conveys it to the tool called a composing stick, which he holds in his left hand. Letter after letter is set up in the same way. Composing consists not merely of thus assembling the types together, and putting the proper spaces between the words, but it includes spreading them out by additional spaces, may be, and making the line of the exact stipulated length. This is called "justifying."

The work of the compositor is, obviously, partly mental and partly mechanical. He has to decipher his copy, to spell the words of which it consists, to judge whether he shall use a capital letter or a small letter, and to punctuate the words. This is the mental part of his work; it cannot be facilitated by machinery. The lifting of the several types and the arranging of them in the stick is mechanical work. It would seem that it might well be done by some kind of mechanism. To provide mechanism for the purpose has been the aim of successive inventors of type composing machines.

At first sight, the designing of a machine for assembling types together and arranging them in orderly manner in lines might not seem to be a task requiring great ingenuity and skill. The difficulties are not apparent until the nature of the problem is somewhat closely considered. Let me point out some of those difficulties.

There is, first of all, the difficulty of operating on such small objects as printing types. Take, for instance, the letter l, in nonpareil. From one end to the other—its height to paper—it is only about $\frac{1}{5}$ of an inch. Its body is $\frac{1}{12}$ of an inch. Its thickness or width is $\frac{1}{28}$ of an inch. Some of the types are much smaller; their thickness is little more than that of a

* Paper read before the Society of Arts.

ously sized, than one which will provide for every combination of letters to be found in the copy to be set up. The hand compositor, as I have mentioned, has types arranged in separate compartments of his case. The instant he sees a certain letter is wanted, he throws out his hand to the particular box in which it is contained, and picks it up. A pair of cases—that is, for an assortment of one face of letter—measures about 2½ ft. one way, and 2 ft. 9 in. the other way. The types are assorted into about 150 boxes. The intelligence and dexterity of the compositor enable him to extract the different types with a certain degree of rapidity and accuracy. To do this by machinery is quite another matter. It cannot possibly be done altogether by mechanism. The selection of the types must be done by the brain of the compositor. What the inventor has to do is to enable us, by mechanism, to assemble together any possible combination of letters found in the words of the copy. This is quite another thing to providing for any one letter, however small, being brought instantly out of its receptacle.

Now, no machine could pick the letters out of an ordinary case and form them into lines of reading matter. The reason is, that they lie in these boxes higgledy-piggledy. The compositor has not only to sight the right type, but he has to put it in the right position in his stick. Accordingly, the types must be arranged in order, the faces all one way, and the nicks all one way. This is the first requirement. The next is that, however the types are located, each one must be accurately brought, as required, to one place—the place corresponding to the composing stick of the hand compositor. This requirement involves the provision of channels, along which the types can be brought to their destination. It also involves means for pushing, or impelling, the types along those channels.

Nearly all inventors of typesetting machines, from the very first, have met this requirement in one way. They have had the types set up in rows, one sort in one row. These rows have been laid side by side, in grooves or tubes. The outlets of these tubes are ranged in a line. Mechanism is provided whereby the first letter in any one of the groups or tubes, or what not, shall be extracted on a key being depressed by the finger of the operator. When he strikes the key a letter in the groove is drawn or falls out. But when it drops out it has to be conveyed to the composing stick. It is led through channels. These channels begin at the mouths of the several tubes. It is necessary that the grooves all converge to a single point, over what I have termed the composing stick. The channels usually consist of grooves cut into a metal plate. This is called a guide plate.

This device is open to many objections, and, indeed, forms the weak part of nearly every machine in which it is adopted. I will mention a few of its drawbacks.

The converging grooves usually have to be adapted for types of different thicknesses being brought down one channel. These arrangements often consist of delicate springs, which, with rough handling of any kind, will get out of order. They are very susceptible to wear, and very liable to disarrangement. There are difficulties arising from the various weights of the letters, and their tendency to fall with unequal velocity. Sometimes they strike the receiver with great force and rebound; sometimes they turn round unexpectedly in their channels; sometimes they stick fast, and have to be released with a bodkin.

The dust and solid particles which often adhere to the grooves, as well as to the types, render their delivery uncertain. Hence the most perfect cleanliness of the guide plate and of the type is essential. Much time is required to properly clean the guide plate, and in the printing office unclean and "sticky" type cannot always be avoided.

In working type that is not entirely clean, the dirt is left on the plate in specks and little heaps. These cause obstructions, and the letters are turned in their course. The objection is of more importance than might at first sight be imagined. It is not felt so much on dry as on damp days. It has been said that typesetting machines work better in some parts of America than in England, because the atmosphere is drier. Possibly there is some truth in this. At any rate, the difficulty arising from such a small cause as insufficiently cleansed type, and a damp guide plate, illustrates the extreme delicacy of such machines, which is one of the chief drawbacks in them.

Again, the types are not always delivered in the receiver in the proper order. This may arise from the operator depressing the keys at a faster rate than the types can be conveyed through the guide plate. Sometimes, too, the types are brought down to the receiver faster than they can be cleared aside for successive letters. The claims of some makers as to their machines being capable of composing types at any speed at which the keys can be touched are certainly not corroborated by experience.

These drawbacks, it is right to state, have, to a certain extent, been remedied in the class of machines called rotary machines. In these the types are ejected in proper order upon a revolving horizontal disk, and are thereby carried to the receiver. These machines are capable of being worked at a much higher rate of speed than the guide plate machines. In several machines, also, the types have been transmitted from their place of storage to the receiver by traveling tapes. Machines of this kind have not proved satisfactory, and have almost gone out of use.

Here may be mentioned another objection to typesetting machines. Some of them cause a great deal of damage to type. In all, unless they are well designed, perfectly adjusted, kept in a proper state of repair and worked by careful, experienced and loyal operators, they may break a considerable weight of type. This item of breakage greatly detracts from the economic advantages of typesetting by machinery. Even if the type is not broken, it may be worn unduly. The edges are often rounded by frequent passage through the guide plate grooves. This wearing especially occurs to the feet of the type, and one result is that they go "off their feet," and all printers know the trouble this occasions.

It cannot be wondered at, I think, that machines of such delicacy and complexity are very expensive. Their expensiveness does not end with their first cost; it is increased by the percentage which has to be allowed for repairs. A typesetting machine with its accompanying distributor costs from £350 to £500 and upward. Only one size and face of type can be advantageously composed with it. I am aware that it is claimed for some machines that they set several sizes of bodies, but the question is, Do they do this at once efficiently and economically? If a considerable time is required to make the change, the advantage may be nullified. A book printer may use ten or more sizes or styles in his work. The cost of buying an equal number of machines would be very great, if not prohibitory. If a machine of this kind is to be even moderately remunerative, it must be kept constantly running. There are few offices, comparatively, in which machines could be kept going without a stoppage for copy or letter. When they are idle the loss is heavy, not only in regard to the capital sunk, but the waste of the time of the operator. In hand composing a man may have to work in a day from half a dozen different pairs of cases. No time is lost in changing from one to the other, but when machines are used every change is a loss.

The cost of running machines and the high rates of wages demanded by skilled operators is another important drawback to any machine which cannot be depended upon to compose a large quantity of type within a given space of time. A special apprenticeship to them is necessary; for some time the operator, even if he is a practical compositor, cannot produce as much composition as if he were working at the case. This deficiency has to be paid for by the employer, and, together with the time absorbed in learning the machine, becomes an important item of expense. Experienced operators, being comparatively few, naturally require higher wages than hand compositors.

So far I have been dealing chiefly with the mechanical problem of setting type by machine and the mechanical difficulties in the way of its successful solution. I now turn to the economic aspect of the subject. The prices at which printing is done have been enormously reduced during the past half century. This has been rendered possible, not by reducing wages—for they have increased—but by the adoption of labor saving machinery. Up to almost the middle of the present century nearly all printing was done on the hand press. Now there is hardly an office in the kingdom in which presswork is not done by machine. Yet what do we find in the composing room? That types are set by hand as they were fifty, one hundred, four hundred years ago. I believe I may say confidently, as the result of careful inquiries, that typesetting machines are to be found in only about a hundred and fifty of the eight thousand printing offices existing in the United Kingdom. Not more than five hundred typesetting machines are, I believe, at present in actual operation.

This fact is the more significant when we remember that typesetting machines have been manufactured and used intermittently for nearly fifty years. During this space of time several hundred patents for typesetting machines have been taken out. Immense sums of money have been spent in carrying out these patents. Printers have spent large sums in buying these machines. One or two of our greatest printing firms have each spent thousands of pounds upon inventions now entirely discarded. Certainly, printers have shown themselves not to be averse on principle to the employment of machinery.

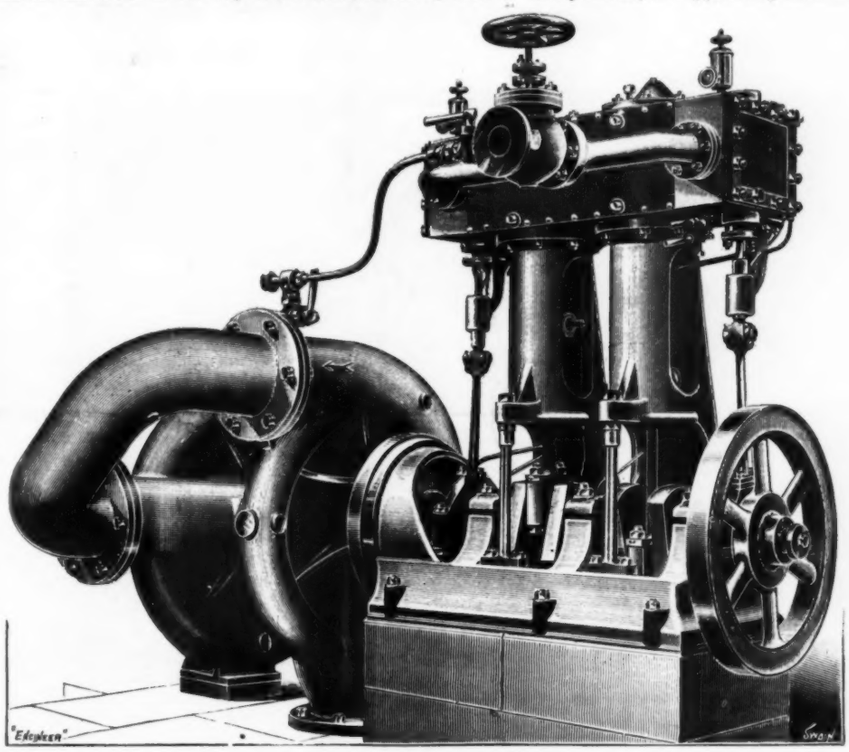
At the present time there are six different kinds of typesetting machines at work in this country. Perhaps it would be more correct to say five, as one of them has only been introduced within the last year or two, and is really a machine brought out in America about fifteen years ago, which has since been practically superseded by later machines. Of the other five, three are in use only in the offices of three firms—two of them book firms, one a great newspaper establishment. These, it is said, are doing good work, and doing it profitably.

The only machines now actually offered for sale to the trade are two. One is made in America, as there is not sufficient demand for it to require a factory for its production here. The remaining one is the only English machine produced commercially. There is only one engineering works, and that not of very considerable magnitude, which is engaged in the production of typesetting machines. The really important patents connected with machines have now all expired, but engineers do not see fit to avail themselves of the fact, and cannot be induced to embark in the business of making such machines.

The reason is perfectly plain. There is not a demand for such machines. There is not a demand for an equally plain reason. The opinion of the great majority of printers—an opinion founded either on their own experience or on that of firms who have tried one of the systems of mechanical type composition—is distinctly unfavorable to them. Although under certain conditions and for certain classes of work, one or other of these machines may be to a certain extent economical in their results, it has been found that ordinary composition is done quite as cheaply—and more conveniently—by hand as by typesetting machines. When there is an economy effected by using appliances of this class, it is not sufficient to justify the heavy first cost of installing machines, of working and of keeping them in order.

Printers are, to say the least, business men, and in no business is it more essential than in theirs that economy should be practiced. If these machines were economical, nearly every office in the kingdom doing book or news work would now possess a composing machine—as every office possesses a printing machine. The fact cannot be got over that while the printing machine is, by reason of its economical working, regarded as indispensable, the typesetting machine is done without, because its economy has never yet been satisfactorily demonstrated.

(To be continued.)



DIRECT-ACTING CENTRIFUGAL SERIES PUMP AND ENGINES.

CENTRIFUGAL SERIES PUMP AND ENGINES.

THE illustration shows a vertical double cylinder steam engine and two centrifugal pumps in series, all driven from one spindle and connected directly to the engine crank shaft. It is suitable for working against heads of 100 ft. and will be found to possess many advantages over pumps of reciprocating type. The construction of the pump is simplicity itself; it has no valves, air vessels, vibration, nor obstruction whatever, and the water passes through it in one continuous stream. It will be found to possess the merit of cheapness in first cost, and the annual charge for repairs is almost nil. By combining the pumps in series, the lift can be augmented to 150 ft. We need scarcely add that the workmanship and material leave nothing to be desired. We are indebted to London Engineer for the cut and copy.

For some time past several of the leading railway companies of Great Britain have been preparing for the forthcoming season's race to Scotland. The Caledonian were the first in the field, and the first of the six new "fliers" which they are building has been completed. The Dunlastair, as it has been named, is said to be the largest locomotive in England. Its pattern is similar to that of the Northeastern Company's, the large Greyhound type, and from buffer to buffer is 34 feet in length, her tank alone being 19 feet long. It has the ordinary size driving wheel, 6 feet 6 inches, and its total weight, when fully watered and coaled for a journey, is 134 tons, as compared with ninety-five tons for last summer's racer and eighty tons in the case of an ordinary passenger bogy locomotive.

LATEST INVENTIONS IN AERIAL NAVIGATION.

By RUDOLPH KOSCH.

IN order to present a clear idea of the experiments I am going to describe, it will be necessary to make the reader acquainted with the most important conditions and principles of aerial navigation, in connection with the names of those aviators whose inventions I closely studied and whose experiments I still watch with greatest interest.

My first impulse I received from Otto Lilienthal's book, published in 1889, "Der Vogelflug als Grundlage der Fliegekunst," in which Mr. Lilienthal, a prominent German engineer, publishes a valuable account of a series of experiments conducted by him since 1870 upon different forms of wings, their resistance and lifting efficiency on rotary and flapping apparatus, and also their lifting efficiency when exposed to the wind. He arrives at the conclusion that slightly concave wings with their hollow side turned downward like those of birds, having an arch depth of from one-eighteenth to one-twelfth of their width, show by far better results in way of lifting than what it has been heretofore supposed, and lift a great deal more than flat wings or planes of the same area and motive power.

He also points out that flapping alternately up and down increases the lifting efficiency to a still greater extent, so that by that operation a wing will lift about nine times as much as when constantly moved in one direction.

It was largely upon the principles laid down in this book that I built my first two machines, which are constructed in such a way as to fully realize the advantages of arched surfaces and beating wings. Mr. Lilienthal has since succeeded in building a pair of arched wings rigidly connected with each other, having room in the center for a man standing in an upright position, and are provided with means for attaching it to the body.

The starting with such an apparatus is managed by running down a steep hill against the wind, which, after some practice, results in actual elevation and soaring against the wind. It looks much like the imperfect imitation of that action of an eagle, by which this bird is soaring afloat for hours, without o e single stroke of its wings, simply by utilizing the almost always prevailing air currents of great altitudes, with an indeed remarkable skill and perfection.

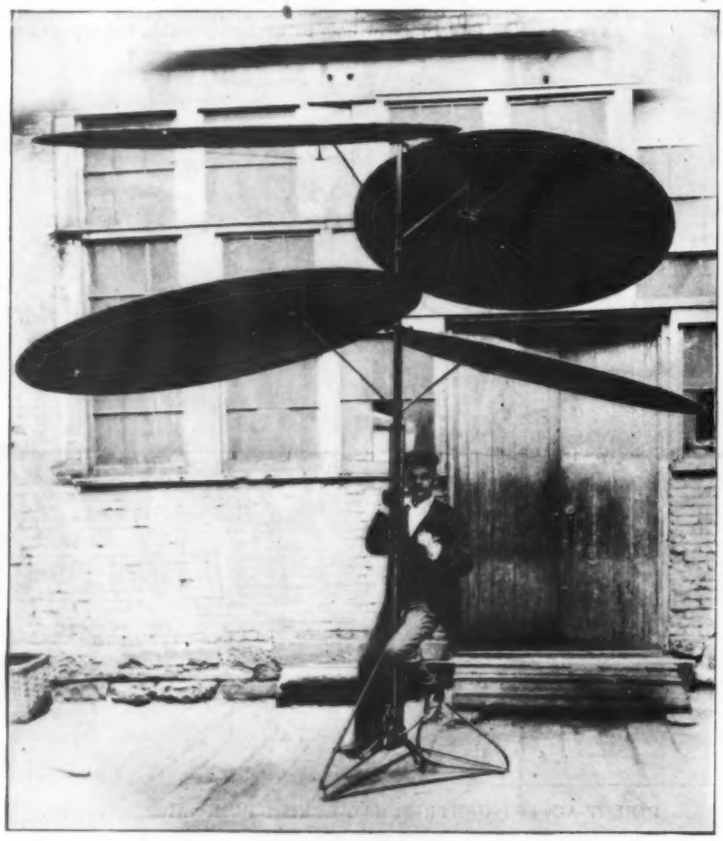
It will be observed that this apparatus can only be used on a windy day, and has nothing whatever provided for propulsion in calm air.

Probably the best illustration of the great lifting efficiency of continuously flapping or beating wings is given by Dr. Louis Martin, professor of the University of Kolozsvar, Hungary, who introduced at a lecture (published in "Magyar Mernok es Epitesz Egylet Kozlonye," Budapest) in 1893, before the Hungarian Society of Engineers and Architects, a small paddle wheel, constructed in such a manner that the paddles reach out into the air and strike it with their total surface at the downward rotating half, while they are drawn together near to and along the shaft by an eccentric guide at the upward revolving half of the wheel so as to hardly encounter any resistance whatever from above when being lifted. With this wheel the professor figured a total weight of 640 kilogrammes, or 1,487 pounds, could be kept floating in the air per horse power. Appropriations made by the Hungarian government enable him to continue experimenting on a larger scale, since it is evident that the lifting efficiency of the wheel makes it a valuable factor for propulsion in aerial navigation.

Experiments of Mr. Hargrave, of Sydney, New South Wales, described and published by O. Chanute, C.E., from time to time in the Engineering and Railroad Journal, New York, also indicate the usefulness of flapping wings, which he applies in a flexible form for driving aeroplanes.

The most remarkable and valuable experiments, however, are those conducted and published by Hiram S. Maxim, and fully described and illustrated in the Century Magazine of October, 1891, and January, 1895. As a matter of fact, Mr. Maxim's flying machine has no equal in aerial navigation from a mechanical standpoint of view, as it comprises the very latest improvements of modern steam engineering, and we find in its construction, as a whole, the best use made of first-class material and workmanship in compliance with the most advanced ideas of structural engineering of the present time. A London paper, Engineering, quotes it as a museum of inventions, for its numerous automatic regulating devices and mechanical improvements. As a result of his preliminary experiments, Mr. Maxim advocates the use of concave aeroplanes, because of their superior lifting efficiency over plane surfaces; still, that he did not adopt the former in constructing his main aeroplane may be simply for structural considerations.

The principal features of this machine are one large main aeroplane and several narrow, but long, side aeroplanes, all of them having their front edge raised above the horizontal at an angle of 7½°; two rudders for steering in a vertical direction, two propeller screws for forward propulsion, which can also be used for steering sideways, by running one faster than the other. Then there are two separate steam engines, one for each screw, and a steam generator or boiler.



KOSCH'S EXPERIMENTAL MACHINE FOR AERIAL NAVIGATION.

The runs made by this machine clearly demonstrate the fact that it is possible to build a machine light and powerful enough to lift itself, and a considerable weight besides its own, and travel at a high velocity through the air. The only objection to Mr. Maxim's machine is the difficulty of ascension, which can be accomplished only by running it along a level track, in order to attain the necessary initial velocity, and for the same reason its landing is rendered unsafe, not being provided with sufficient means for propulsion in a straight, vertical direction. This difficulty I propose to do away with by my machine.

The apparatus consists mainly of two pairs of wings. Each pair rotates in a horizontal plane, but in different directions when being operated, so that turning the upper pair to the left will cause the lower pair to turn to the right. Both pairs of wings can be flapped down simultaneously while being turned, and then they appear in a combined flapping rotary motion. The wings can also be set in relation to the shaft in such a way that the front edge of each wing, that is the edge which goes ahead in the direction of rotation, is raised to any suitable angle around a pinion of the shaft, so that the two pairs of wings will appear and work like two propeller screws, one right and the other left handed. The blades can be moved up and down while being turned. The motor of this apparatus is operated by a man, who sits in the saddle and turns the crank shaft by means of common bicycle pedals, causing the wings to rotate while they are being flapped up and down by handles, shown higher up on the shaft.

It will be observed that when the wings are set like screw blades, they will perform a wavelike motion similar to the wing motion of a forward flying bird, the only difference being that the bird's wing travels up and down and forward, while these move up and down and around one center, in both cases the lifting of the wings being accomplished without any loss of power and supporting area by gliding them up on an incline equal to the angle of incidence of the wings. No special effort is necessary to raise the wings directly, because they will resume their horizontal position on account of the screw action due to their inclination and on account of the centrifugal force due to rotation. The flapping action of the wings, which, as stated before, is far superior to any other, is thus applied in such a combination as to fully realize its advantages at the down stroke and to obtain a considerable lifting effect at the up stroke.

After having reached the desired elevation by the screw and flapping action of the wings, these latter are stopped and set in a horizontal position, and driven forward like aeroplanes, by another pair of propellers of smaller size but higher speed, which, however, are not yet applied to this apparatus.

There are two bevel gears on the crankshaft engaging those fastened to the lower ends of the two upright shafts from the right and left side respectively, causing the outside tubular shaft to turn right and the other projecting and extending through the first one to turn left. The wings are attached to the hubs of the upper ends of the respective shafts, with a pin allowing each wing to swing up and down around that pin. A spiral spring fastened to the top end of the longer shaft keeps the wings, by means of wire arms, in a horizontal position. Other wires serve for flapping them down, the ends of these being fastened to the hubs of the wings and to the shaft armature respectively, while the handles of the armature are finally held by the operator, who moves them up and down with his hands while turning the pedals by his feet.

The wings are circular in shape and resemble bicycle wheels in construction. They have, to my knowledge, never been adopted by aviators before. It may be because they are too simple, or too close within reach, that they have been so easily overlooked. Still I think the circle will be the final form of the future aeroplanes and this statement the following simple but important reasons may account for.

The circle has the largest area inclosed by the smallest circumference among all geometrical forms. To illustrate this, let us compare a circle of an area of 200 square feet, which has a circumference of 50 feet, with a quadrangle 20 feet long and 10 feet wide, the area of which is likewise 200 square feet, having a circumference of 60 feet. This latter being 10 feet longer than the circle, 10 feet more tubing will have to be used to form the outlines of said quadrangle against that of a circle. The actual difference in weight will be much more than that, though, because for bracing the rim of a wheel only thin steel wires are necessary, as spokes fastened to a short tubular hub in the center, while with a rectangular form probably five times as heavy tubing will have to be employed to stiffen the frame in order to get the same strength and stiffness as with the wheel. One of the wings in Fig. 1 is six feet in diameter, having an area of 2,827 square feet, weighs only five pounds without covering. If Mr. Maxim's aeroplanes would be built on the same principle, the frame work of his 4,000 square feet of sustaining surface would not be more than about 700 to 800 pounds, which is, I am pretty sure, far below the figure of what it actually weighs.

The construction of circular wings is very simple, and consists in bending steel tubing cold to the desired circle. Over this is drawn the balloon fabric (cambric was used in my experiments), consisting of two sheets sewed together around the circumference, with the exception of about 6 inches where the tubular rim is drawn in. In order to obtain the desired arch, the fabric is uniformly covered with grain of some kind of the weight of the assumed air pressure, which is taken 2·5 to 3 pounds per square foot, and while loaded in this manner, the height of the arch formed by the fabric is measured. The right dimension, which is one-eighteenth to one-twelfth of the diameter, can soon be arrived at by making the necessary corrections on the sewing machine. After this is done, the steel rim is drawn in once more, its ends joined by a sleeve, and the spokes drawn in and tightened with nuts, preferably employed at the center post.

These facts about lightness, strength and uniform shape speak plainly in favor of this system, which I am sure will be soon adopted in modern flying machine construction.

After various experiments with machines of other construction, I finally completed, in August, 1895, the machine shown in the engraving, having a weight of 56 pounds and wings of 6 ft. 4 in. diameter, which can be flapped either simultaneously or alternately up and down by means of two independent handles, so that one pair of wings goes up while the other is flapping down. This alteration was made in order to prevent sinking while the wings are being lifted. The spring on the top of the first apparatus was done away with and substituted by stiff connecting arms for supporting and operating the wings. The center posts or hubs of the latter have been removed somewhat sideways, in order to get a more suitable leverage. The gear ratio is 3 to 1, and 21 ball bearings were necessarily used to reduce the friction of all the revolving parts. The wings on the picture are flapped down somewhat and set like screw propeller blades.

This apparatus has been tested with wings set at various angles, first with two pairs of wings and then with one pair only, showing about the same results in both cases. Four wings were not lifting more than two by the same number of turns.

Angle of incidence in degrees.	Revolutions per minute.	Lift in pounds.	Kind of operation.
5	75	6	Turning.
5	75	31	Turning and flapping.
10	72	17	Turning.
10	72	50	Turning and flapping.
15	60	5	Turning.

The results given above indicate the lifting efficiency

of one pair only, and show that an angle of 10 degrees is about the most favorable, the lift being 17 pounds in that instant, without flapping.

To illustrate the practical value of these figures, let us assume an average pressure of 120 pounds on the pedals that made 24 revolutions a minute while the wings made 72. The 120 pounds are supposed to act constantly in a tangential direction on the crank ends, which were 7½ inches long. Thus, 120 × 94·248 divided by 33,000 (see Haswell Mech. and Eng. Pocket Book), is equal to 0·34 horse power expenditure in lifting 17 pounds of weight. Gear friction consumes about half of 0·34, consequently there will be left but 0·17 horse power to lift 17 pounds of weight, which is equivalent to 100 pounds lift per one horse power. As the above figuring is only approximate, because the presumed average foot pressure may have been a trifle more or less than 120 pounds, let us say that in the worst case half of the above, or 50 pounds, are only lifted by one horse power, which I think we can be perfectly sure of obtaining under any circumstances.

Summing up the results of these tests, it will be learned that propellers should be arranged side by side in order to get the best results out of them. Further on we see that flapping will not have to be applied to increase the efficiency, because screw action alone will be sufficient to lift a flying machine, like that of Mr. Maxim, for instance, which weighs only 22 pounds per horse power, lifting 28 pounds at a forward velocity of 40 miles per hour.

The two upright shafts are connected by a rigid frame, which is provided with an oblong platform for boiler and fuel, then with spiral springs for the whole machine to rest on, and a gallery for passengers. Two state-rooms are preferably suspended by long spiral springs from the upper beams of the framework, thus practically rendering harmless any accident the air ship should meet with.

By means of levers the wings can be set either parallel to each other like aeroplanes, as shown in the lower side view, or at an angle like screw blades, as shown in the upper side view of the drawing.

Another pair of levers serve for operating two pairs of friction clutches arranged on each side of the two engines respectively. Said clutches make it possible to use the same engines for either driving the sustaining propellers by means of bevel gears, or belting or rope transmission, or for directly driving the two high speed propellers, serving for forward propulsion.

Boiler, water, fuel and condenser, constituting the heaviest part of the machinery, are located on the lowest platform to insure stability, and are used for steering the airship in a vertical direction, simply by sliding them as a whole forth and back on the frame; this action will change the center of gravity in relation to the aeroplanes, and cause the airship to be elevated or lowered, while moving forward. A special small steam capstan serves for moving the platform forth and back by simple pulley and rope transmission. This device can be of great importance in case of disabled machinery and broken aeroplanes, by sliding the whole platform clear off the frame, down to the ground, which would insure a slow and comparatively safe landing of the remaining airship proper and its occupants.

Flying machines traveling at the rate of 100 miles and more an hour, exceeding the greatest wind velocities by 40 to 50 miles, are the ideal means of communication of the near future, and will be far superior to anything yet invented for passenger transportation.

I feel pretty confident that suggestions in form of comment and criticism upon the subject by aviators, prominent engineers, and business men, will soon have the desired effect in helping the idea to a state of perfection, to meet all requirements of modern passenger transportation.

In conclusion of the foregoing we may sincerely hope that before long a practical flying machine will be an accomplished fact, demonstrating the possibility and safety of aerial navigation and serve as a basis of the fast long distance passenger transportation of the next century.

[Continued from SUPPLEMENT, No. 1064, page 17009.]

AUTOMATIC FIRING GUNS.*

By HIRAM STEVENS MAXIM.

II.—INTRODUCTION OF RIFLING.

THE rifled barrel was invented in Germany; according to some, at Leipzig, in 1498; according to others, at Vienna, by Gaspard Zollner. †

Most writers assign the invention of spiral grooved arms to Gaspard Zollner, gunmaker of Vienna, in the year 1498, though others state that his barrels had straight grooves, and that he first applied the system to arms for target practice at Leipzig. Other writers attribute the invention to Augustus Kotter, of Nuremberg, 1500 to 1520; but however that may be, most seem agreed that the honor of the invention is due to the Germans. As a military arm, it was not adopted until the seventeenth century. In 1631, William, Landgrave of Hesse, had several companies armed with rifled carbines. ‡

The rifling of gun barrels may be considered to date in England from about the end of the sixteenth century; but the earliest patent for rifling is dated in the year 1635. §

* From Industries and Iron.

† Demmin, "Arms and Armor," 1877.

‡ Greener, "The Gun," 1884.

§ Lacombe, "Arms and Armor," in notes by Boutell, 1883.

In order to overcome the evil effects caused by the windage of projectiles, bullets fitting close into the barrel were driven in with iron ramrods, but this was a slow process, owing to the foulness. To render it easier grooves were cut throughout the interior length of the barrel, into which, when the bullet was rammed down, the foulness was driven. This invention is ascribed to Gaspard Zollner, of Vienna, in 1498. Greater accuracy was also the consequence, but experience showed that this accuracy could be further increased by giving to the bullet such a form as would cause it to fit into the grooves, and giving these latter a spiral turn relative to the axis of the bore. What led to these innovations is unknown; but we find that at Nuremberg in 1522 such weapons were in use, and since then they have been applied to war weapons, the inclinations of the grooves varying in different countries.*

The first rifle grooves that were made were parallel with the axis of the gun bore; but in Germany spiral grooves were soon made, exactly as they are made in the French rifles of the present day. If it should be asked from what motive the rifle grooves were made to assume a spiral line, we reply that the projectile has been proved to have both a longer and a truer flight when it moves rotating on its own axis. Even before the first invention of fire arms, in the palmy days of the cross bow, in the fourteenth century, this important fact was ascertained, and efforts were accordingly made to impart to the cross bow bolts a rotary movement, by arranging the feathers with which they were flighted in spirals upon the bolt shafts. Spiral grooves in rifles are another and a more effectual means for arriving at the same result. We see that the principles which govern our modern arms may be traced sufficiently far; consequently, we may feel surprised that the invention of guns of long range and exact precision should have been delayed until our own era. †

It may perhaps be asked, What have these theoretical questions to do with the practice of artillery? A sufficient answer will be found in the fact that Robins ("New Principles of Gunnery," 1742), by his explanations of the true value of rifling and of the advantages to be derived from the use of elongated projectiles, anticipated the late revolution in fire arms by a hundred years. Had practical men attended to his suggestions, rifled guns might have been introduced in the last century. His prophecy was remarkable: "I shall therefore close this paper with predicting that whatever state shall thoroughly comprehend the nature and advantages of rifled barrel pieces, and, having facilitated and completed their construction, shall introduce into their armies their general use, with a dexterity in them, they will by this means acquire a superiority which will almost equal anything that has been done at any time by the particular excellence of any one kind of arms, and will, perhaps, fall but little short of the wonderful effects which histories relate to have been formerly produced by the first inventors of fire arms." ‡

INVENTION AND APPLICATION OF RIFLING.

At the present day all military men will admit that the rifle possesses great advantages over the old smooth bore, but it must not be supposed for a moment that the rifle earned an easy victory over this now obsolete arm; rifling, in fact, was invented many years ago, and it has long been known that with a properly constructed rifle, great accuracy of fire was possible.

* Jarvis, "The Rifle Musket," 1859.

† Lacombe, "Arms and Armor," 1868.

‡ Owen, "Modern Artillery," 1873.

Just before the Crimean war a great deal of experimenting took place in England and France with the view of so perfecting the rifle that it might be employed as a military arm by common soldiers, but the great stumbling block seems to have been the fouling. The projectiles had to be made smaller than the bore to allow for fouling; the space between the bullet and the barrel was called windage. If too much space was allowed, the gases escaped without communicating sufficient velocity to the projectile; moreover, with too much windage the projectile did not take the rifling, whereas if the projectiles were made so as to fit the bore approximately, only a few rounds could be fired before it was found quite impossible to ram the projectile home. In some of these early military rifles, it was attempted to expand the bullet by the ramrod after it was in position, but this so distorted the projectile that the accuracy of fire was destroyed. Good marksmen at this time were able to shoot with a high degree of accuracy, provided the barrel was cleaned after each discharge, and a greased patch employed, but the impediments required for loading the arm in this manner, together with the slow rate of fire, prevented it from being introduced as a military arm. However, the Minie rifle, having a projectile with a cupped base, was employed to some extent in the Crimean war, but it was not until after the introduction of metallic cartridges and breech-loading mechanisms that it became possible to so reduce and simplify the rifle as to make it practical for use in the hands of the common soldier.

When this was once accomplished, it led to a great number of improvements in breech-loading fire arms, and many hundreds of patents were taken out, especially in England and the United States.

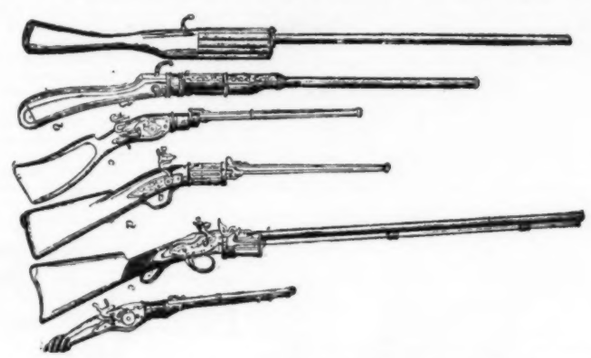


FIG. 5.—GROUP OF FIFTEENTH CENTURY REVOLVERS.

FIG. 6.—HALL'S BREECH LOADER.
Patented 1811.

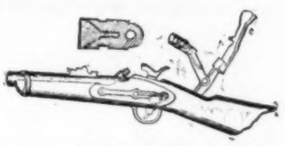


FIG. 7.—THE MERRILL GUN.

I herewith present in Fig. 5 some of the earlier forms of breech-loading fire arms.

a. Matchlock of the fifteenth century in the Tower of London.

b. An arquebuse with six chambers.

c. An arquebuse in the Tower of London, with six chambers in a revolving breech.

d. Is the arm of John Dafts, of London, and has six chambers.

e. Is Elisha Collier's arm, patented in the United States in 1818.

f. Is a revolving chamber flint lock pistol at Woolwich.

Hall's is the first patent for a breech-loading fire arm ever issued in the United States. It will be seen from the engraving that the barrel is in two pieces, the breech being articulated to the shoe of the gun in such a manner that the front end may be tilted up to receive the charge. It can, therefore, be loaded without a ramrod, and admits of a projectile being inserted which is larger than the bore of the rifle. About 10,000 of these arms were made in the United States, to be used against the Indians.

FIG. 8.—AN OLD REPEATING FLINT LOCK, BY S. NORTH, MADE IN MIDDLETOWN, CONNECTICUT, IN 1825.

The Merrill arm was constructed for using paper cartridges. The breech was closed by a sliding plug, locked in place by a combination of levers. The cartridge was exploded by a copper cap placed upon the nipple in the ordinary manner.

In Fig. 8 is shown an old repeating flint lock rifle, by S. North, made in Middletown, Connecticut, in 1825.

In this arm a series of charges were placed in the barrel, the firing commencing, of course, with the charge nearest the barrel. There was danger, however, of firing the wrong charge, or having the fire run back and fire all the charges at about the same time. Rifles were made and sold in the States as late as 1855 which were loaded in this way, but only two charges were employed with two percussion nipples.

The Allen gun was double-barreled, the breech block being hinged at the side, swinging upwardly and laterally. It carried both firing pins, and was locked by a latch.

Perhaps this was the most remarkable rifle of its time; it certainly did more to popularize rifles than any other invention that had preceded it. The barrel is firmly secured to the stock, and the breech is closed by a vertical sliding breech block, similar to that employed in the Hotchkiss quick-firing guns of to-day. The cartridge was made of cloth, having the end nearest to the breech block closed by tissue paper, which was saturated with nitrate of potash. In some of the early types of this arm, the breech block was made to cut off the end of the cartridge and expose the powder on being closed. One of the principal advantages of this arm over others was that a supply of percussion caps was placed in the magazine, held in position by a spiral spring, and arranged in such a manner that the action of the breech placed a fresh cap on the nipple by the act of opening the breech. The lever for working the breech formed a part of the trigger guard. The accuracy of this arm was very much superior to any other rifle of its time. The celebrated John Brown, of Osawatomie and Harper's Ferry notoriety, employed this form of rifle with great effect against the border ruffians of Missouri. At that time John Brown and a large number of Northern

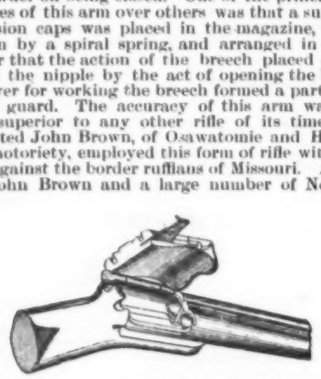


FIG. 9.—THE ALLEN GUN.

FIG. 10.—SHARP'S BREECH-LOADING RIFLE.

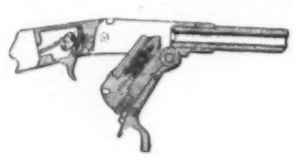


FIG. 11.—BURNSIDE'S RIFLE.

FIG. 12.—WESTLEY-RICHARDS' BREECH-LOADING RIFLE.

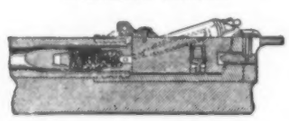


FIG. 13.—THE SNIDER RIFLE.

FIG. 14.—THE SPENCER RIFLE.

men were attempting to make the territory of Arkansas a free State, while Missourians were equally determined to make it a slave State. John Brown, after having two sons assassinated, procured a supply of Sharp's rifles. On one occasion, when a troop of about one hundred border ruffians were making a raid into the territory for the avowed purpose of carrying off John Brown, dead or alive, he lay in ambush for them with four of Sharp's rifles and four men to load. When they had reached a position on a plain about 400 to 500 yards distant, he opened fire, and before they could escape he had killed over twenty of them. This little episode did much to popularize this rifle, and it was very largely employed at the time by English and American sportsmen for large game.

In this rifle the breech block is pivoted to the barrel in the manner shown, and may be swung downward and forward, leaving a free space for the introduction of the cartridge.

This arm has a dropping breech block, and its action is similar to that of the well-known Martini-Henry.

In this well-known arm the breech block is hinged to the rear end above the barrel. The block thrown upward and forward exposes the chamber in the rear of the bore; into this the cartridge is dropped, pushed into the bore, the lock brought down and locked by a latch in the rear. The firing pin passes obliquely through the block, and is struck by the ordinary form of hammer.

This is both a magazine and a single breechloader, seven cartridges being placed in a magazine in the butt which are thrown forward into the chamber as required. The breech block is a sector pivoted beneath the level of the barrel, and retreating backward and downward, it exposes the rear of the bore for the insertion of the cartridge. The trigger guard forms the lever for moving the breech block. This is probably the first magazine rifle that ever had anything like an extensive use as a military arm. A large number of these rifles were issued to the Northern troops in 1863 and 1864.

Fig. 15 represents Laidley's rifle, which is an arm having many features in common with the Remington. The locking of the breech, however, is performed in a slightly different manner.

The breech block of this rifle is in two pieces hinged together. The firing pin passes diagonally through the combined pieces.

This arm has a breech block pivoted in the rear, and operates by the lever which extends backward over the small part of the stock, the forward end of the breech block being depressed, the same as in the Martini-Henry. The hammer, however, is located to the rear of the dropping block, and in this feature it differs from the Martini-Henry of the present day.

This may be considered the first bolt gun which ever went into extensive use. It was employed in 1866 by

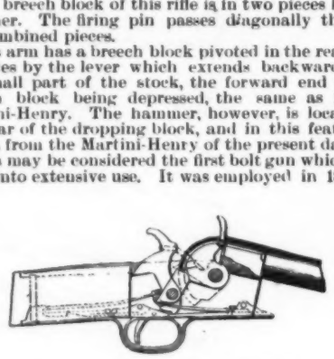


FIG. 15.—LAIDLEY'S RIFLE.

FIG. 16.—THE BERDAN RIFLE.

FIG. 17.—THE ROBERTS BREECH-LOADING RIFLES.

FIG. 18.—PRUSSIAN NEEDLE GUN.

FIG. 19.—CHASSEPOT RIFLE.

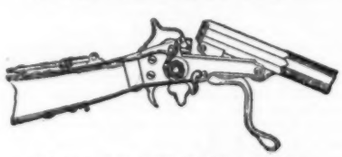


FIG. 20.—MAYNARD'S RIFLE.

the Prussians in their brilliant campaign of six weeks against the Austrian Empire. This was the first time that a practical breech-loading fire arm was ever employed on a large scale by a European army, and the execution which it did was so great that it led to a change in military fire arms all over the world. The projectile was egg shaped. A novel feature of this arm was the position of the fulminating capsule, which was placed on the base of a sabot between the powder charge and the projectile, the fulminating capsule being detonated by a needle which passed completely through the powder charge. The locking of the bolt was performed by a partial rotation on its own axis. This arm was also used in the Franco-German war.

Fig. 19 represents the Chassepot rifle which was the original breech-loading rifle of the French army. The loading and firing was performed in almost exactly the same manner as in the Prussian needle gun, a needle being also employed for igniting the charge. Both this and the needle gun were much inferior to the Martini-Henry, which was afterward used in England and Turkey.

Maynard's rifle was popular for some time in the United States on account of its great accuracy of fire. The barrel is pivoted to the stock, the rear end being tilted up to receive the charge. A novel feature in this arm was that it employed pellets of fulminating powder placed at regular intervals between narrow strips of paper; this was coiled in a chamber in the lock, and was fed forward by the action of a wheel that was operated by the hammer in such a manner that a fresh pellet was brought on top of the nipple at each discharge. These rifles were employed to a considerable extent by the rebel sharpshooters in the American civil war. They appear, however, to have been made in the first instance as target rifles.

(To be continued.)

A NEW FORM OF RADIATION.*

As my investigations will have to be interrupted for several weeks, I propose in the following paper to communicate a few new results.

§ 18. At the time of my first communication it was known to me that X rays were able to discharge electrified bodies, and I suspected that it was X rays, not the unaltered cathode rays, which got through his aluminum window, that Lenard had to do with in connection with distant electrified bodies.

When I published my researches, however, I decided to wait until I could communicate unexceptionable results. Such are only obtainable when one makes the observation in a space which is not only completely protected against the electrostatic influences of the vacuum tube, leading-in wires, induction coil, etc., but which is also protected against the air coming from the vicinity of the discharge apparatus. To this end I made a box of soldered sheet zinc large enough to receive me and the necessary apparatus, and which, even to an opening which could be closed by a zinc door, was quite air-tight. The wall opposite the door was almost covered with lead. Near one of the discharge apparatus placed outside, the lead covered zinc wall was provided with a slot 4 cm. wide, and the opening was then hermetically closed with a thin aluminum sheet. Through this window the X rays could come into the observation box. I have observed the following phenomena:

(a) Positively or negatively electrified bodies in air are discharged when placed in the path of X rays, and the more quickly the more powerful the rays. The intensity of the rays was estimated by their effect on a fluorescent screen or on a photographic plate. It is the same whether the electrified bodies are conductors or insulators. Up to the present I have discovered no specific difference in the behavior of different bodies with regard to the rate of discharge, and the same remark applies to the behavior of positive and negative electricity. Nevertheless, it is not impossible that small differences exist.

(b) If an electrical conductor is surrounded by a solid insulator, such as paraffin, instead of by air, the radiation acts as if the insulating envelope were swept by a flame connected to earth.

(c) If this insulating envelope is closely surrounded by a conductor connected to earth, which should like the insulator be transparent to X rays, the radiation, with the means at my disposal, apparently no longer acts on the inner electrified conductor.

(d) The observations described in a, b, and c tend to show that air traversed by X rays possesses the property of discharging electrified bodies with which it comes in contact.

(e) If this be really the case, and if, further, the air retains this property for some time after the X rays have been extinguished, it must be possible to discharge electrified bodies of such air, although the bodies themselves are not in the path of the rays.

It is possible to convince one's self in various ways that this actually happens. I will describe one arrangement, perhaps not the simplest possible. I employed a brass tube 3 cm. in diameter and 45 cm. long. A few centimeters from one end a portion of the tube was cut away and replaced by a thin sheet of aluminum. At the other end an insulated brass ball fastened to a metal rod was led into the tube through an air-tight gland. Between the ball and the closed end of the tube a side tube was soldered on, which could be placed in communication with an aspirator. When the aspirator was worked, the brass ball was surrounded by air, which on its way through the tube went past the aluminum window. The distance from the window to the ball was over 20 cm. I arranged the tube in the zinc box in such a manner that the X rays passed through the aluminum window at right angles to the axis of the tube, so that the insulated ball was beyond the reach of the rays in the shadow. The tube and the zinc box were connected together; the ball was connected to a Hankel electroscope. It was seen that a charge (positive or negative) communicated to the ball was not affected by the X rays so long as the air in the tube was at rest, but that the charge immediately diminished considerably when the aspirator caused the air traversed by the rays to stream past the ball. If the ball by being connected to accumulators was kept at a constant potential, and if air which had been traversed by the rays was sucked through the tube, an electric current was started as if the ball had been connected with the wall of the tube by a bad conductor.

(f) It may be asked in what way the air loses this property communicated to it by the X rays. Whether it loses it as time goes on, without coming into contact with other bodies, is still doubtful. It is quite certain, on the other hand, that a short disturbance of the air by a body of large surface, which need not be electrified, can render the air inoperative. If one pushes, for example, a sufficiently thick plug of cotton wool so far into the tube that the air which has been traversed by the rays must stream through the cotton wool before it reaches the ball, the charge of the ball remains unchanged when suction is commenced. If the plug is placed exactly in front of the aluminum window the result is the same as if there were no cotton wool, a proof that dust particles are not the cause of the observed discharge. Wire gauze acts in the same way as cotton wool, but the meshes must be very small and several layers must be placed one over the other if we want the air to be active. If the nets are not connected to earth, as heretofore, but connected to a constant potential source of electricity, I have always observed what I expected; however, these investigations are not concluded.

(g) If the electrified bodies are placed in dry hydrogen instead of air, they are equally well discharged. The discharge in hydrogen seems to me somewhat

* Second communication to the Wurzburg Physico-Medical Society — By Prof. Wm. K. Roentgen. Reprinted from the translation in Electricity.

slower. This observation is not, however, very reliable, on account of the difficulty of securing equally powerful X rays in successive experiments. The method of filling the apparatus with hydrogen precluded the possibility of the thin layer of air which clings to the surface of the bodies at the commencement playing an appreciable part in connection with the discharge.

(h) In highly exhausted vessels the discharge of a body in the path of the X rays takes place far more slowly—in one case it was, for instance, seventy times more slowly—than in the same vessels when filled with air or hydrogen at atmospheric pressure.

(i) Experiments on the behavior of a mixture of chlorine and hydrogen, when under the influence of the X rays, have been commenced.

(j) Finally, I should like to mention that the results of the investigations on the discharging property of the X rays, in which the influence of the surrounding gases was not taken into account, should be for the most part accepted with reserve.

§ 19. In many cases it is of advantage to put in circuit between the X ray producer and the Ruhmkorff coil a Tesla condenser and transformer. This arrangement has the following advantages: first the discharge apparatus gets less hot, and there is less probability of its being pierced; second, the vacuum lasts longer, at least this was the case with my apparatus; and third, the apparatus produces stronger X rays. In apparatus which was either not sufficiently or too highly exhausted to allow the Ruhmkorff coil alone to work well, the use of a Tesla transformer was of great advantage.

The question now arises—and I may be permitted to mention it here, though I am at present not in a position to give answer to it—whether it be possible to generate X-rays by means of a continuous discharge at a constant discharge potential, or whether oscillations of the potential are invariably necessary for their production.

§ 20. In § 13 of my first communication it was stated that X rays not only originate in glass, but also in aluminum. Continuing my researches in this direction, I have found no solid bodies incapable of generating X rays under the influence of cathode rays. I know of no reason why liquids and gases should not behave in the same way.

Quantitative differences in the behavior of different bodies have, however, revealed themselves. If, for example, we let the cathode rays fall on a plate, one-half consisting of a 0·3 mm. sheet of platinum and the other half of a 1 mm. sheet of aluminum, a pin-hole photograph of this double plate will show that the sheet of platinum emits a far greater number of X rays than does the aluminum sheet, this remark applying in either case to the side upon which the cathode rays impinge. From the reverse side of the platinum, however, practically no X rays are emitted, but from the reverse side of the aluminum a relatively large number are radiated. It is easy to construct an explanation of this observation; still it is to be recommended that before so doing we should learn a little more about the characteristics of X rays.

It must be mentioned, however, that this fact has a practical bearing. Judging by my experience up to now, platinum is the best for generating the most powerful X rays. I used a few weeks ago, with excellent results, a discharge apparatus in which a concave mirror of aluminum acted as cathode and a sheet of platinum as anode, the platinum being at an angle of 45° to the axis of the mirror and at the center of curvature.

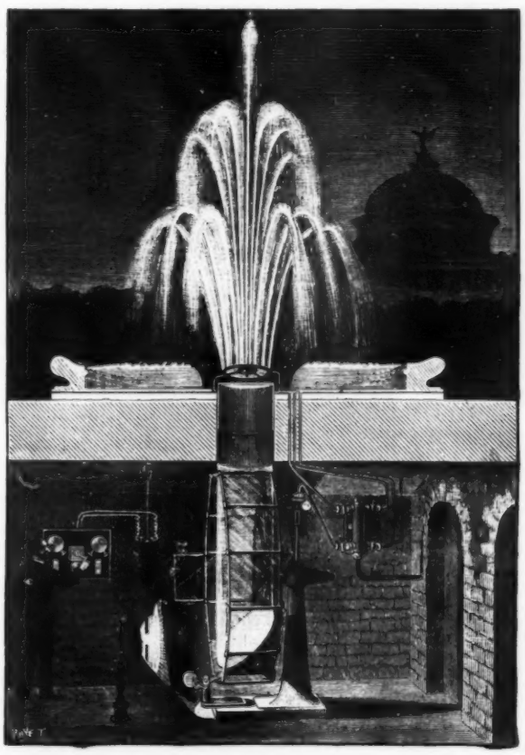
§ 21. The X rays in this apparatus start from the anode. I conclude from experiments with variously shaped apparatus that as regards the intensity of the X rays it is a matter of indifference whether or not the spot at which these rays are generated be the anode. With a special view to researches with alternate currents from a Tesla transformer, a discharge apparatus is being made in which both electrodes are concave aluminum mirrors, their axes being at right angles; at the common center of curvature there is 'a cathode ray catching' sheet of platinum. As to the utility of this apparatus I will report further at a later date. —W. K. Roentgen.

LUMINOUS FOUNTAINS.

MR. A. ADAMOFF, a well known manufacturer of Baku (Caucasus), has just introduced an innovation into the operation of luminous fountains. We are happy to make known the principal advantages of it to our readers, whom the subject interests, and, at the same time, to give them a succinct description of this ingenious invention, which, we think, is destined to have a great future in France, as well as in other countries.

The majestic luminous fountains of the Exposition of 1889 that all visitors had an opportunity of admiring owed their great and deserved success only to the skillful combinations of the motions of levers, cordage and pulleys designed to actuate the frames that carried the colored glass. But this remarkable installation was costly and complicated.

It is precisely such complication that the Adamoff invention suppresses. To every fountain or wheat sheaf jet there is appropriated an apparatus called the "Adamoff prismatic wheel," which consists of two parts—a piston hydraulic motor and a wheel, the whole supported by a cast iron frame. The piston of the motor communicates its alternating motion to the wheel by means of a cam with which there successively engage steel rollers arranged regularly and circumferentially upon a disk. This latter and the wheel are interdependent. The wheel, which is prismatic in form, with a regular polygonal base, revolves projectingly in its support. It is arranged to receive the frames into which the colored glass is set, and which may be very easily replaced during the operation.



NEW ARRANGEMENT OF AN ELECTRIC LUMINOUS FOUNTAIN.

This wheel is installed in a room beneath the fountain. An aperture closed by transparent glass is formed under the basin in order to permit of the passage of the luminous rays through the colored glass of the polygonal wheel. The accompanying figure shows us the various arrangements adopted. In the subterranean room situated beneath the fountain we see to the right the different parts of the hydraulic motor, and, in the center, the polygonal wheel that carries upon its periphery the different frames for the fixing of the glass.

The luminous source employed is an arc lamp placed in a parabolic reflector, which may be seen at the left side of the figure. This lamp is situated either directly in the interior of the wheel or externally to it. In the latter case, the luminous pencil is directed upon a plane mirror which sends it, in its turn, in the proper direction. The electric energy for the operation of the arc is furnished by a small, separate installation, and reaches the distributing board shown to the left against the wall. This board is provided with an interrupter, a circuit breaker, a voltameter and an amperemeter. From the board the wires go directly to the lamp. A system of cocks and valves permits of causing the wheel to revolve intermittingly, and of regulating the duration of the stoppages at will. It will be understood, then, that if we have, for example, ten or fifteen apparatus grouped in a maneuvering room, we can, since such apparatus are all submitted to the pressure of a conduit of water, regulate all the motors to the same velocity and thus obtain regular changes of color, whose combinations have been determined in advance.

It will be understood, besides, that it is possible to obtain a great variety of effects by giving the motors different velocities and by making varied colors rapidly succeed one another.—La Nature.

THE USE OF DRUGS.*

By W. R. GOWERS, M.D. Lond., F.R.S.

THE physician's experience of the use of drugs is acquired under conditions not altogether favorable. It is his task to deal with cases that have resisted the efforts of practitioners who are often wise, persevering and equipped with knowledge in a degree increasingly adequate and effective. Success in treatment by drugs after such antecedent efforts seems to me to testify to the undeveloped capacities in the means employed. However this may be, I am convinced that the method of treatment to which the average practitioner is chiefly restricted now, as he was in the past, to which he is limited by a compulsion not less at the present time than in former days, has not only a power that can be realized now, but also a potentiality yet to be developed.

It has therefore been with great interest that I have seemed of late to see more clearly why this should be. When I say "I have seemed to see it," I do not mean that it is not conspicuous to many. The skepticism regarding the use of drugs to which I have referred is, I think, less now than a few years ago. One favorite foothold was the statistical demonstration of inutility—as, for instance, that the average duration of acute rheumatism was the same whatever treatment was employed or when no agents were used. That is no longer possible, since we have sought help from the willow which casts its shadow on the damp places in which there thrive the bane and antidote. Since the salicylates were employed I fancy the significance of the loss of this convenient argument has been felt. Then, moreover, the empirical advice, "Try all things; hold fast that which is good," to which in the hands of peasants we owe many of our most precious aids, has been applied to the results of modern chemistry, and every tangible achievement of science has been seized by the "advanced pharmacy" of the present day.

THE POTENCY OF DRUGS.

But can we discern the reason why drugs are useful? Consider. I show you two tubes. Each contains a small quantity of a white powder—about half a teaspoonful. Each consists of the same elements. One is practically harmless; the other contains within it the power of death to 1,000 men. The one is quinine; the other is aconitine—the alkaloid which makes so deadly the plant whose flower our ancestors called "monkshood" in the far-off days when the original was always before their eyes. It is an almost startling fact that in this minute quantity of powder, hardly visible to those at a distance, there is such a potentiality of death. Picture to yourselves 1,000 men. That which is in this tube would end the life of every one of them. There is a latent power within this powder beside which the lightning flash is feeble, and to which the earthquake might give place, so far as the comparison depends on lethal certainty. But the resemblance in the aspect of these two substances is not all. As I said, each consists of the same elements; each is made up of carbon, nitrogen, oxygen and hydrogen. Each consists of the elements which compose air and water, with some carbon added—soot, if you like. Why is one almost harmless, and the other a most deadly poison? I might have chosen for the lower term of the comparison a simple food, but then the amount of nitrogen would have been less and resemblance in construction less close. The answer may be given, "It depends upon the chemical constitution." True, but this takes us a very little way. When we discern that the difference depends upon the way in which the atoms of the elements are arranged in molecules, and the molecules are grouped together, we are no nearer an explanation. We see a little more, however, when we realize that chemical constitution means that energy is held "latent" (as it is said) ready to be released when the elements can form simpler, closer compounds, and that on the same kind of constitution and the same kind of simpler union, and similar release of energy, in the constituents of the living tissues seems to depend all vital function. As far as we can see, all the energy which is released in the animal body is released in consequence of chemical union under the mysterious influence of life. When such union and such release are going on, the process may be changed entirely by the contact of molecules of allied constitution, with latent energy on the point of release, so held as to blend with that which is being set free as living tissue. Blending with this, it may augment or oppose it. Remember that a difference in chemical constitution means a difference in the readiness with which the elements separate and reunite, and on this depends the effect exerted by the energy they bear. I have recently endeavored to explain this in a small book,† in which you can, if you desire, pursue these conceptions.

NERVE FORCE,

as far as we can see, is the result of such chemical change occurring under the influence of life in the molecules which compose nerve tissue. Chemical compounds may come into relation with the substance in which change is occurring without exerting the slightest influence upon it. But another substance may come, even in amount inconceivably minute, whose molecules are so arranged as to fit in as it were with the changing molecules of the living tissue. The energy the new molecules bear seems to blend with that which is in process of ordered release in the living tissue, and to blend so suddenly and so effectively as to derange it entirely. The various nerve tissues which compose the centers seem to us the same but they must differ in their precise chemical nature and in the precise chemical action which their life work involves. This

* Extract from an address delivered before the Harleseien Medical Society.—From the London Lancet.

† "The Dynamics of Life." London: J. and A. Churchill, 1894.

fact is revealed to us only by their different response to different chemical agents, but the revelation is often a startling one. The difference in response is certain, the uniformity in the nature of the agent is certain, and therefore the difference in result must be due to a difference in that on which the agent acts. Although we have no other evidence of this, consider the absolute significance of such facts as that atropine acts first upon the nerve substance of the eye and strychnine upon that of the spinal chord.

THE ACTION OF ACONITINE.

Such an influence as I have spoken of seems to be almost universal in the case of aconitine. Its contact with any acting nerve structure seems to be, as it were, so direct, instant, and precise as to generate as it were an avalanche of energy, sweeping all before it, or opposing the process of liberation of energy with a momentum that involves a sudden stillness among the whirling atoms whose throb is far below the range of human sense. Among the nerves thus influenced may be those on which depends the action of the heart, and with a sudden spasm or a sudden stillness the heart stops and life is ended. That which so acts we call a poison. Widely different from this as is that vehicle for energy which we call a food, the difference is one of degree. Every form of food is such by taking to the tissues new energy in fresh molecules. Between the two—the poison and the food—there is an almost infinite gradation of substances whose influence is exerted in like way by chemical compounds upon the chemical processes of life, upon the state of nutrition and upon the mode of action of the living tissues. It is in this intermediate region that there is the range of therapeutic influence conveyed by the vehicles we call drugs. The difference is of course in part one of quantity. But it is by the relation of the latent energy of the agent to the energy being released in the tissue, and to the secondary effect of the action thus produced upon nutrition, that one wide scope for the influence of drugs can be readily perceived. There are others, but they are different aspects of the same influence, and the facts may, I think, be best epitomized by the statement that treatment by drugs would be correctly named "dynamical therapeutics."

OXIDATION IN THE SYSTEM.

Although I believe that it is generally true that what we call "matter" is only effective, whether it be employed as food, medicine, or as poison, because it is a vehicle for energy, some apparent exceptions should be at least mentioned. In the functional action of all structures in the body, molecules are constantly passing off which, having formed with oxygen lower compounds and having yielded their latent energy, are useless, and these are constantly being replaced by others formed under the influence of life from the material which the plasma has brought to the vicinity of the structure. It is possible that the molecules of some poisons may enter into the constitution of the tissues in abnormal amount, and thus disturb function by deranging the release of energy. There are also some cases in which atoms of some different element seem to enter and replace normal atoms, and thus derange. Whenever arsenic is brought in contact with the nerve elements, whatever be its combination, it induces not only functional, but also structural changes in these, leading ultimately to their degeneration. We can only explain this by supposing that atoms of arsenic are taken up by the nerve substance in the course of the molecular renewal which attends functional action, and it is reasonable to suppose that this is due to its close relation to phosphorus, which we know is a constituent of the nerve material. It is possible that such substitution may take place in a slight degree without any injurious consequences, and even, in morbid states, with benefit. The influence on the nutritional process may be actually beneficial when this is already in some way deranged. It may promote the subsequent due assimilation of phosphorus, and make this more adequate and effective. Of course this is only a speculation. It is sometimes a help to conceive how that may be which we cannot but perceive as a fact.

These remarks have reference, of course, only to the medicinal agents which act through the blood. There is a considerable scope for thought regarding the action of agents which do not pass into the blood, which act only upon the surface, or on that portion of our real exterior which is within us, as the alimentary canal. In this region, moreover, there is some room for bringing conception to the test of experiment. Many purgatives, of course, act through the blood, but chemical processes seem to take less part in the operation of saline aperients. These act rather by "flushing out," the liquid in which the salt is dissolved, being merely added to by osmosis and exciting contraction. The subject, indeed, requires more special study than it has received. The great service of salines seems to me to be effected by removing that which would be in part reabsorbed.

EMPIRICISM AND RATIONALISM.

One other phase of modern therapeutical thought is to me a mystery. It is the contrast which is often drawn between the empirical and the rational in the use of drugs, and the disparagement of the former in comparison with the latter. Possibly it is a result of the influence of the scientific training which now dominates medical education. Beneficial as this training is, its influence may acquire a momentum that carries the effect too far, and, indeed, its influence may spread too widely for the good of those whose lives are to be devoted to the hard and often routine work of applying knowledge. The intense love for pure science begotten in the better class of medical students of the present day, warm with the ardor of youth, makes them slow to sink into the grooves to which they are predestined, and hinders their perception of that which they might gain and see therein. They yield at once to the distinction between the rational in therapeutics and the merely empirical. It is all very well to esteem the rational, but we have, I hope, seen that this esteem should not be allowed to cause an aversion from that which is precious, and yet cannot be called "rational" in the common, narrow sense of the word. The antithesis of the empirical and the rational is itself an error. It is an instance of a common tendency to put a positive conception into a negative word. Because the empirical is not the rational, it is conceived as irrational—the only simple negative we have, but one that implies far more than simple absence of the quality excluded. The "irrational" should be merely the "not rational," but in effect it carries us as far beyond neutrality as does "unreasonable." No one means by "unreasonable" a simple absence of the quality of reasonableness. We are so accustomed to the use of the mere negative for the opposite positive that an effort may be necessary to perceive the real meaning of the words. Not only is the empirical not positively irrational; it is doubtful how we are justified in considering that a truly rational element is absent from the empirical. The term "rational therapeutics" is applied to treatment in which a drug is given with success in accordance with preconceived ideas or with a theory. The theory may turn out quite wrong, although the result is the same. What, then, becomes of the rationality? In empirical therapeutics a drug is given because it is found by experience that in the particular condition it does good. Often we cannot even guess why.

THE THEORY OF MEDICINAL TREATMENT.

But the fact remains, and surely to act upon observed experience is as truly a rational proceeding as is action upon a theory which may be incorrect. After all, the medicinal treatment which can be based upon any definite theory is small. How seldom, moreover, can we use a drug to advantage which was discovered save by the purest empiricism. In not one drug in twenty, perhaps not one in fifty, of those of most certain service, can the use be traced to anything except unguided experiment. Our knowledge of these drugs, derived from the past—and often from the distant past—must be assumed to be the result of experiments innumerable, perhaps continued through the long tens of centuries in which the human race has lived among surroundings which alike compelled and suggested endeavors to counteract disease by every available means. The need for food must itself have led men to a knowledge of the physiological action of most herbs of the field, especially when domestication brought the habits of animals under observation, habits such as must have had the power of example. It is probable that since man became able to observe and to reason, every common herb of the field and fruit of the tree has been at some time tested, and thus by slow degrees the knowledge of a physical good and evil has been acquired.

OUR DEBT TO THE HERBALISTS.

It is strange, indeed, to note how far back goes the use of the drugs on which we most rely. Most of them can be traced into the mists of the popular knowledge which it so easy to sneer at and would be so difficult to do without, or until they are lost in the bluer mists in which the distance shrouds alike the hills of Greece and deserts of Arabia, or to the time when the world learned its wisdom from the land where now only the sculptured symbols of man's thought stand silent in the cold moonlight of a long dead past. We smile at the popular herbal remedies. But it is to these that we owe the majority of our most useful drugs. I cannot conceive a therapeutist surveying a list of the chief drugs on which we depend in our daily work—and do not depend in vain—without a sense of wonder and perhaps of humiliation. We disinfect our rooms with burning sulphur; and so men did before the time of Homer. We purge sometimes with rhubarb, especially when some subsequent astringent influence is desirable, and so did the old Arabians for the same special reason. The value of castor oil in its chief use was familiar, probably for ages, to the natives of the East and of the West Indies before it was made known in Europe by a physician from Antigua 150 years ago. Aloes was employed in the same way long before the time of Dioscorides and Pliny. The knowledge of the influence of ergot in parturition we owe to the peasants of Germany, and the use of male fern for tapeworm goes back to the old Greeks and Romans. The employment of mercury in syphilis by inunction and fumigation, which our nineteenth century therapeutists regard with such satisfaction, seems to go back to the time of the crusades, and it is said that its use can be traced in Malabar as far back as the ninth century. Podophyllin as a purgative we owe to the North American Indians. If we go through all the drugs on which we most rely, we find the same story. Even in the case of those which are the latest additions to our resources, we find that, with very few exceptions, their use arose from what we must regard as pure empiricism. It was by accident that the local anæsthetic influence of cocaine was discovered. The unexpected results of simple experiments afforded us the chief use of antipyrine; and that which is perhaps the greatest practical discovery of modern times in the influence of drugs on disease—the use of bromides in epilepsy—was the result of a chance observation of its use on an allied state—also empirical. To this day we are without any rational perception of its mode of action or of the reasons for its use in given cases. I yield to no one in my sense of the importance of the rational in therapeutics; but we need to be careful lest, in contrasting the rational and the empirical, we allow our esteem for the one to induce a depreciation of the other. We can afford to despise no source or kind of help, or to permit our estimate to be lessened by the many warping influences to which our thought is liable.

I have, indeed, tried to frame a definition of rational therapeutics which I could illustrate by examples. I will not say that I have wholly failed, but my success is not sufficient to let me submit it for your consideration. But the attempt has impressed me with a doubt as to the propriety of considering that a theory, to explain an empirical discovery, makes the therapeutics rational. It is very easy to frame a theory of the action of a drug, and it is easy to extend this theory to the nature of the disease in which the drug does good, and at the same time to ignore the many other possible ways in which the effect may be produced, and so to build from a small and uncertain foundation an edifice which some new knowledge may reduce to that which most builders call "rubbish."

Dr. Aronsohn, of Berlin, has succeeded in inoculating a goat with tuberculosis. The goat has been regarded hitherto as an animal immune to this disease.

BUILDING EDITION
OF THE
SCIENTIFIC AMERICAN.

Those who contemplate building should not fail to subscribe.

ONLY $2.50 A YEAR.

Each number contains elevations and plans of a variety of country houses; also a handsome

COLORED PLATE.

MUNN & CO., 361 Broadway, New York.

THE
Scientific American Supplement.
PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
361 Broadway, New York, N. Y.

TABLE OF CONTENTS.

PAGE

I. AERONAUTICS.—Latest Invention in Aerial Navigation.—By RUDOLPH KOSCH.—Experiments with circular aeroplanes and direct determinations of their lifting effect, with full description of the experimental machine.—1 illustration 17009

II. ARCHÆOLOGY.—An Old Roman Vessel in Lake Nemi.—A most valuable find.—The remains of an ancient vessel enriched in bronze ornaments, with views of the same.—1 illustration 17002

III. BIOGRAPHY.—Naar-ed-Din, the Late Shah of Persia.—Notes on the life of the late Shah of Persia; his personal peculiarities, and his successor; with portraits.—2 illustrations 17010

IV. BOTANY.—Some Curious Facts in Plant Distribution.—By W. BOTTING HEMSLEY.—Interesting phenomena in the growth of plants in different regions of country.—The introduction of species of flora in new regions 17006

V. CHEMISTRY.—The Chemical Laboratories of Germany.—By Prof. A. B. PRESCOTT.—A very valuable and timely article upon the administration of German students' laboratories and the methods of instruction adopted there.—First installment of an exhaustive review of the subject 17007

VI. CIVIL ENGINEERING.—Mixed Constructions, with Metallic Skeletons.—A very interesting system of constructions in the line of civil engineering, using metallic skeletons and cement body.—6 illustrations 17003

VII. HISTORY OF SCIENCE.—The Origin of the Bessemer Process.—A further contribution to the Bessemer-Kelly controversy in the matter of the invention of the Bessemer steel process 17003

VIII. MECHANICAL ENGINEERING.—Centrifugal Series Pump and Engines.—Direct connected duplex rotary pump connected in series.—1 illustration 17005

Heavy Hydraulic Riveting Machine.—A very powerful boiler riveting machine with opening for large and deep work.—1 illustration 17004

IX. MEDICAL.—The Use of Drugs.—By W. H. GOWERS.—A review of drugs and their action on the system from the standpoint of a physician.—A valuable review of the subject 17009

Note on the Inoculation of a Goat with Tuberculosis 17000

X. MISCELLANEOUS.—Luminous Fountains.—A beautiful electric fountain recently invented, showing different colors and utilizing the arc lamp 17009

The Nile Expedition.—Notes on the British expedition to and campaign in Upper Egypt.—2 illustrations 17015

Electrical Notes 17001

Engineering Notes 17001

Miscellaneous Notes 17001

Selected Formulæ 17000

XI. NAVAL ENGINEERING.—The Austro-Hungarian Fleet on the Danube.—Notes on ships of the Austro-Hungarian Navy built at Budapest.—1 illustration 17002

XII. ORDNANCE.—Automatic Firing Guns. II.—Introduction of Rifling.—By HIRAM STEVENS MAXIM.—Continuation of this classic article on repeating firearms of all ages.—16 illustrations 17007

The Largest Armor Plate Ever Tested.—A 38 ton 15 inch armor plate, attacked by a 10 inch gun, at Bethlehem, Pa., proving grounds.—Results of the trial 17015

XIII. PALÆONTOLOGY.—The Gigantic Birds of Southern Patagonia.—A graphic and popular account of extinct birds whose remains have been found in Patagonia.—4 illustrations 17010

XIV. PHOTOGRAPHY.—Comparative Exposures for Lantern Slides by Contact and Reduction.—By Rev. G. T. PURCHAS, B.A.—A valuable paper, with formulæ on the time of contact exposure for lantern slides 17000

XV. PHYSICS.—A New Form of Radiation.—A second communication by Prof. W. J. ROENTGEN on his world famous discovery giving the details of his last researches 17008

XVI. RAILROAD ENGINEERING.—Note on the Largest Locomotive in England 17005

XVII. TYPOGRAPHY.—Machines for Composing Letterpress Printing Surfaces.—By JOHN SOUTHWARD.—Commencement of a London Society of Arts lecture on machines for typesetting 17004

XVIII. TECHNOLOGY.—Note on Purifying Black Lead 17000

CATALOGUES.

A Catalogue of Valuable Papers contained in SCIENTIFIC AMERICAN SUPPLEMENT during the past ten years, sent *free of charge* to any address; also, a comprehensive catalogue of useful books by different authors, on more than fifty different subjects, has recently been published, for free circulation, at the office of this paper. Subjects classified with names of authors. Persons desiring a copy have only to ask for it, and it will be mailed to them. Address

MUNN & CO., 361 Broadway, New York.

PATENTS!

MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had *nearly fifty years' experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Labels, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.

A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them; directions concerning Labels, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases. Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws, showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York.

BRANCH OFFICES.—No. 622 and 624 F Street, Pacific Building near 7th Street, Washington, D. C.